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MANAGEMENT OF PHYSICS TEACHING ACTIVITIES IN UPPER SECONDARY SCHOOLS IN VIETNAM'S CENTRAL HIGHLANDS IN THE CURRENT CONTEXT

Major: Educational Management
Code: 9140114

SUMMARY OF DOCTORAL DISSERTATION IN EDUCATIONAL SCIENCES

Da Nang, 2026

THE DISSERTATION WAS COMPLETED AT THE UNIVERSITY OF SCIENCE AND EDUCATION - THE UNIVERSITY OF DANANG

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Reviewer 3: ....

The dissertation will be defended before the University-level Doctoral Dissertation Evaluation Council at the University of Science and Education - The University of Danang at ... on ... ... 2026.

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INTRODUCTION

1. Rationale

In the context of educational reform (ER) and digital transformation (DT), teaching activities in upper secondary schools are shifting from knowledge transmission to the organisation of learning activities aimed at developing learners' qualities and competences. This transformation not only changes teaching methods but also requires the renewal of teaching-activity management: from monitoring plans, schedules and professional records to governing the whole teaching process, including the teacher element, the learner element and the learning environment, on the basis of data, evidence and regular feedback mechanisms.

For Physics, this requirement is especially urgent because Physics is an experimental science associated with observation, experimentation, simulation, measurement, data processing and the application of knowledge to real-life situations. From the perspective of interactive pedagogy (SPTT), Physics teaching is a process of organising and coordinating interactions among the teacher, the learner and the learning environment. In a digital ecosystem, these interactions are expanded through digital learning resources, learning management systems (LMS), online platforms, virtual experiments, simulations and learning data. Therefore, the management of Physics teaching activities needs to operate as an integrated, interconnected and data-based whole.

Existing studies have mainly focused on administrative-professional management or on separate aspects such as methodological innovation, STEM teaching, simulations and student competence development. They have not fully clarified the mechanism for managing the interaction among teaching, learning and the environment within a digital ecosystem. This gap is even more evident in Vietnam's Central Highlands, where schools differ substantially in technological infrastructure, laboratory equipment, digital learning resources, digital competence and conditions for organising teaching. Hence, studying the management of Physics teaching activities in upper secondary schools in the Central Highlands in the current context is theoretically and practically necessary.

2. Aim and research tasks

On the basis of developing a theoretical framework for Physics teaching activities and their management from the perspective of interactive pedagogy, the dissertation evaluates the current situation of Physics teaching and management in upper secondary schools in the Central Highlands in the context of ER and DT; it then proposes appropriate management measures to improve the effectiveness of Physics teaching-activity management.

The dissertation performs three tasks: (1) building a theoretical framework for teaching activities and teaching-activity management in upper secondary schools, thereby proposing an Integrated Framework for the Management of Physics Teaching Activities from the perspective of SPTT in a digital ecosystem; (2) surveying and evaluating the current situation of Physics teaching activities and their management in upper secondary schools in the Central Highlands in the context of ER and DT; and (3) proposing measures for managing Physics teaching activities in upper secondary schools in the Central Highlands within a digital ecosystem.

3. Object, subject, scope and research questions

The research object is Physics teaching activities in upper secondary schools. The research subject is the management of Physics teaching activities in upper secondary schools in the Central Highlands in the current context. The research context is limited to educational reform and digital transformation. Survey respondents include school administrators, professional officers of Departments of Education and Training, Physics teachers and students studying Physics. The research was conducted in provinces of the Central Highlands; survey data from 40 upper secondary schools were determined according to the administrative boundaries before 1 July 2025; the research period extends from 2022 to the present.

The dissertation addresses three questions: (1) In the context of ER and DT, what issues do Physics teaching activities in upper secondary schools pose for school management? (2) What difficulties and barriers currently exist in Physics teaching activities and their management in upper secondary schools in the Central Highlands? (3) What management measures are needed to remove these difficulties and barriers and contribute to improving the effectiveness of Physics teaching-activity management?

4. Scientific hypothesis

In the context of ER and DT, the management of Physics teaching activities in upper secondary schools still has limitations that need to be addressed. If an Integrated Framework for the Management of Physics Teaching Activities from the perspective of SPTT in a digital ecosystem is developed and management measures appropriate to the conditions of upper secondary schools in the Central Highlands are proposed, then the implementation of these measures will contribute to improving the effectiveness of Physics teaching-activity management.

5. Research methods

The dissertation employs the following approaches: management functions, interactive pedagogy, data-based governance and systems thinking. The research methods include analysis, synthesis and systematisation of theory; bibliometric analysis; questionnaire survey; semi-structured interviews; analysis of activity products and records; expert method; a one-group pre-test/post-test experimental design; and descriptive statistics, paired-sample t-test, ANOVA, correlation and regression analysis using SPSS 26.0.

Three five-point Likert-scale questionnaires were used for administrators, teachers and students. The current-situation survey combined quantitative data with interviews and product/record analysis for triangulation. The appraisal assessed the necessity and feasibility of nine measures. The experiment of Measure 2 used pre-test and post-test data, t-test, ANOVA and regression to evaluate the level of change and the relationship between the components of the measure and management effectiveness.

6. Theses to be defended

First, in the context of ER and DT, the Integrated Framework for the Management of Physics Teaching Activities from the perspective of SPTT - including the management of the teacher element, the learner element and the learning environment in a digital ecosystem - is an appropriate approach for improving management effectiveness.

Second, DT changes the learning environment and generates large sources of data, creating both challenges and opportunities for teaching and for the management of teaching activities; therefore, the exploitation of data and digital evidence is an inevitable requirement for management actors.

Third, the system of measures proposed by the dissertation is necessary, feasible and contributes to improving the effectiveness of Physics teaching-activity management; it can be applied in other regions after being adjusted to specific conditions.

7. New contributions of the dissertation

The dissertation systematises and clarifies the theoretical basis of Physics teaching activities and their management in upper secondary schools from the perspective of SPTT. It proposes an Integrated Framework for the Management of Physics Teaching Activities in a digital ecosystem, in which the three components - teacher, learner and environment - are connected by data, digital evidence and feedback mechanisms. The framework operates through two interconnected logical layers: the management-function layer and the governance-function layer.

The dissertation identifies the current situation and barriers in managing Physics teaching activities in upper secondary schools in the Central Highlands, especially the lack of interconnection among teaching, learning and the environment, and limitations in digital competence, infrastructure, learning resources and data-based governance. On this basis, it proposes nine measures in three groups. The appraisal and experimental results provide initial evidence of necessity, feasibility and effectiveness, particularly clarifying the central, activating and coordinating role of Measure 2.

Chapter 1. THEORETICAL BASIS FOR THE MANAGEMENT OF PHYSICS TEACHING ACTIVITIES IN UPPER SECONDARY SCHOOLS IN THE CURRENT CONTEXT

1.1. Research overview

International bibliometric review and VOSviewer analysis show that research in Physics education has gradually shifted from teaching methods and learning outcomes towards digital learning environments, LMS, digital resources and educational data. However, management and leadership of Physics teaching activities have not emerged as an independent research axis. In Viet Nam, studies mainly address teaching-method innovation, STEM, assessment, technology application and competence development; there is still a lack of systematic research on the integrated management of the teacher element, the learner element and the learning environment in a digital ecosystem, especially in the Central Highlands.

From the reviewed works, the dissertation identifies a research gap: Physics teaching has been studied in relation to active learning, experiments, simulations, STEM and digital tools, but the management of Physics teaching activities as an integrated system of teaching, learning and environment in a digital ecosystem has not been sufficiently theorised or empirically examined.

1.2. Key concepts

The dissertation defines teaching activities as a goal-oriented social-pedagogical process constituted by interactions between the teacher, the learner and the learning environment. Management of Physics teaching activities from the perspective of SPTT is a goal-oriented process in which the management actor influences these three elements through management functions and data-based governance mechanisms in order to realise the objectives of Physics competence development and improve teaching quality. The digital ecosystem in Physics teaching includes actors, platforms, devices, learning resources, data and interaction relationships connected within a unified environment.

1.3. Physics at upper secondary level

Physics at upper secondary level is an experimental science aimed at developing three components of competence: Physics cognition; inquiry into the natural world from a Physics perspective; and application of learned knowledge and skills. These characteristics require teaching to be associated with observation, experimentation, simulation, modelling, data processing, problem solving and real-life application; they also require appropriate management of curriculum, staff, equipment, subject classrooms, digital resources and the learning environment.

1.4. Theory of Physics teaching activities in upper secondary schools

From the perspective of SPTT, the teacher designs, organises, guides and supports; the learner actively constructs knowledge; and the learning environment - material, psychological and digital - serves both as a condition and an agent of interaction. Physics teaching activities include objective setting, organisation of teaching, organisation of learning, assessment, and the exploitation of experiments, simulations, learning resources and digital platforms to strengthen interaction, self-study, collaboration, experience and Physics competence development.

1.5. Theory of management of Physics teaching activities in the current context

In this dissertation, the digital ecosystem in Physics teaching is understood as a learning environment organised on digital technology platforms, in which teachers, students, digital resources, teaching equipment, learning data, technological platforms and management activities are connected to support interactions among the teacher, the learner and the environment for the achievement of Physics teaching objectives.

The dissertation proposes an Integrated Framework for the Management of Physics Teaching Activities from the perspective of SPTT in a digital ecosystem. The framework comprises three components: management of the teacher element, management of the learner element and management of the learning environment. It operates through two interconnected logical layers. The management-function layer includes planning, organisation, direction, inspection, evaluation and adjustment. The governance-function layer emphasises data governance, digital evidence, resource coordination, support for teachers and students, progress monitoring, feedback and evidence-based decision-making. Data connect the three components and ensure a continuous improvement cycle.

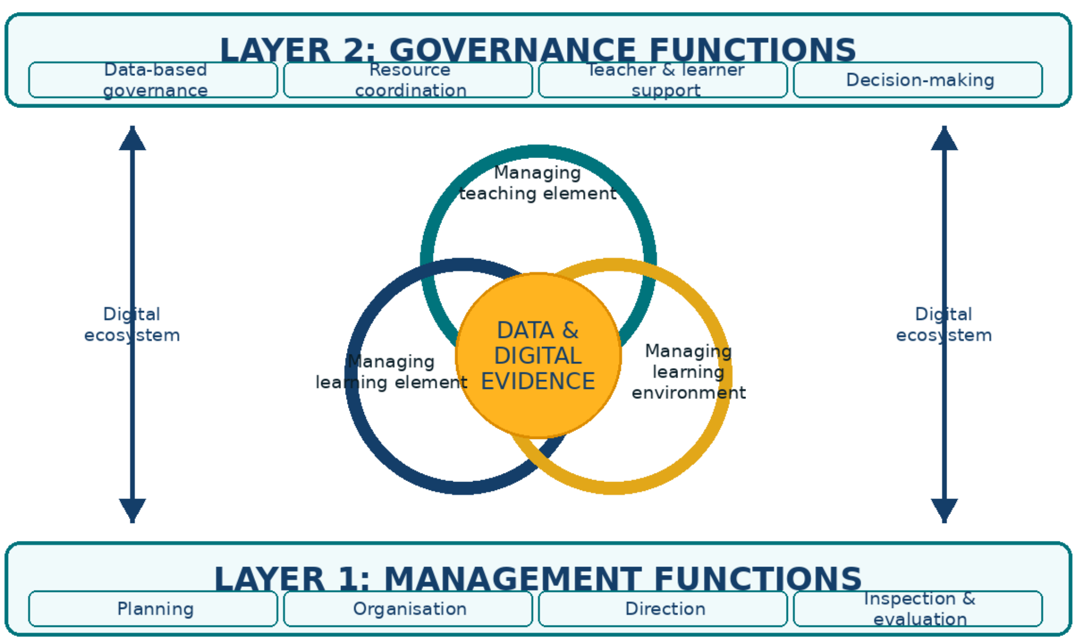

Figure 1. Integrated framework for managing Physics teaching activities in a digital ecosystem

1.6. Factors influencing the management of Physics teaching activities

The influencing factors are grouped into three categories: (1) implementation capacity, including the management capacity, professional capacity and digital competence of administrators, heads of subject groups and teachers, as well as students' capacity for digital self-study; (2) implementation conditions, including infrastructure, laboratory equipment, digital learning resources, platforms, class size and regional characteristics; and (3) governance mechanisms, including task allocation, coordination, process standardisation, data governance, monitoring, feedback and adjustment. Correctly identifying these factors is an important basis for organising the management of Physics teaching activities in an integrated, interconnected and data-based manner.

Conclusion of Chapter 1

Chapter 1 establishes the theoretical basis for approaching Physics teaching activities as a system of interactions among the teacher, the learner and the environment. It also proposes an integrated management framework based on two layers: management functions and governance functions. This framework provides the foundation for building survey instruments, comparing the current situation, identifying barriers and proposing management measures suited to the conditions of upper secondary schools in the Central Highlands.

Chapter 2. PRACTICAL BASIS FOR THE MANAGEMENT OF PHYSICS TEACHING ACTIVITIES IN UPPER SECONDARY SCHOOLS IN THE CENTRAL HIGHLANDS IN THE CURRENT CONTEXT

2.1. Overview of upper secondary education in the Central Highlands

The Central Highlands has a relatively extensive school network; the teaching staff have been gradually strengthened and educational quality has improved. However, upper secondary schools are affected by socio-economic conditions, terrain, population distribution and differences between central areas, peripheral areas, remote and disadvantaged areas. Facilities, laboratory equipment, Internet connections, simulation software, digital learning resources and technological exploitation capacity remain uneven, directly affecting the organisation of competence-oriented Physics teaching.

Respondent group	Valid sample size and survey content
Administrators	201 valid questionnaires from 40 upper secondary schools; reflecting perceptions, management of teacher, learner and environment elements, influencing factors and management outcomes/effectiveness.
Physics teachers	230 valid questionnaires; evaluating perception and orientation, teaching activities, learning activities, learning environment, influencing factors and outcomes of Physics teaching activities.
Students	403 valid questionnaires; reflecting learning experiences, experiences of the learning environment and Physics learning outcomes.

Policy support for ER and DT and increasing investment provide a foundation for innovation. Nevertheless, difficulties in infrastructure, equipment, staff, digital competence and data-governance mechanisms require measures with appropriate roadmaps, effective use of existing resources and stronger regional linkage and sharing.

2.2. Organisation of the survey and assessment

The survey was conducted at 40 upper secondary schools selected through stratified random sampling, representing provinces and areas including wards, central communes and communes far from centres according to the administrative boundaries before 1 July 2025. Among 860 participants, 834 valid questionnaires remained after data cleaning (97%), including 201 administrators, 230 Physics teachers and 403 students. The dissertation also interviewed 48 participants in 16 schools (16 administrators, 16 teachers and 16 students) and analysed 96 documents from eight record sets for the school years 2024-2025 and 2025-2026.

Data were collected using three questionnaires, semi-structured interviews and analysis of activity products. They were processed with SPSS 26.0 using descriptive statistics, Cronbach's Alpha reliability testing and correlation analysis. Quantitative results were cross-checked with interview and record data to clarify manifestations, causes and the gap between policy orientation and implementation capacity.

2.3. Current situation of Physics teaching activities

2.3.1. Teachers' perceptions of the context and orientation of Physics teaching activities

Teachers' perceptions and orientations reached a fair level ($M = 3.95$; $SD = 0.824$). Teachers clearly recognised the inevitability of renewing Physics teaching in a digital environment (highest criterion: $M = 4.46$), but support for applying DT and AI remained limited (lowest criterion: $M = 3.39$). This reflects a gap between positive awareness and practical capacity as well as mechanisms for regular support.

2.3.2. Current situation of Physics teaching activities

Physics teaching activities were assessed at a fair level ($M = 3.98$; $SD = 0.854$). Teachers paid attention to competence-development goals, curriculum content and assessment, but implementation levels were uneven. The use of LMS, digital resources, simulations, AI, learning data and computer-connected laboratory equipment remained limited. In some schools, DT mainly stopped at presentation and had not become a data-based teaching process.

2.3.3. Current situation of students' Physics learning activities

Students' learning activities showed positive changes in participation, collaboration and problem solving when supported by teachers. However, self-study capacity, digital learning, resource exploitation, feedback reception and the application of Physics knowledge to real life were uneven. The link between home self-study, classroom learning and post-learning feedback on digital platforms remained weak, indicating a need to shift from assigning tasks to governing learning processes based on data.

2.3.4. Current situation of the Physics learning environment

The learning environment was the component with lower results than the others (teachers: $M = 3.83$). Subject classrooms, equipment and practice conditions provided a certain foundation, but digital infrastructure, Internet connections, digital laboratory devices, learning-resource repositories, simulation software and mechanisms for resource sharing were not synchronous. The environment was mainly managed as a set of conditions, rather than operated as an ecosystem linking experiments, simulations, resources, data and feedback.

2.3.5. Factors influencing teaching activities

The factors affecting Physics teaching activities were grouped into implementation capacity, implementation conditions and governance mechanisms. Teachers' digital competence, students' digital self-study capacity, class size, uneven infrastructure, lack of learning resources and equipment, and incomplete coordination and data-governance mechanisms limited the quality of interaction and the sustainability of innovations in Physics teaching.

2.3.6. Results of Physics teaching activities

The outcomes of Physics teaching activities were assessed at a fair level but were not uniform or sustainable. Comparing teacher, student and record data shows that awareness of innovation was relatively good, but its conversion into Physics competence, interest, confidence, self-study and students' ability to apply knowledge depended considerably on the quality of teaching organisation, teacher support and learning-environment conditions.

The current situation confirms that improving Physics teaching quality cannot focus on a single element. It requires simultaneous development of teachers' digital and pedagogical capacity, governance of students' learning processes, strengthened interaction and personalisation, and the organisation of the material, psychological and digital environment as an ecosystem supporting competence development.

2.4. Current situation of management of Physics teaching activities

The survey of 201 administrators showed that the management of Physics teaching activities reached a fair level but remained dispersed across schools. The functions of planning, organisation, direction, inspection and evaluation were carried out, but the management cycle was not fully closed; data governance and digital evidence remained weak, and management of the learning environment had the lowest score. The findings show that the management-function layer has been formed relatively fully, whereas the governance-function layer has not operated synchronously.

2.4.1. Perceptions and orientations of management

Administrators' awareness of ER and DT requirements reached a fair level ($M = 3.806$; $SD = 0.899$), but varied among units. The criterion on integrating the management of the three pillars - teaching, learning and environment - reached only an average level ($M = 3.31$), indicating that DT awareness had formed but had not been fully transformed into integrated and data-based governance thinking.

2.4.2. Management of the teacher element in Physics

Management of the teacher element focused on planning, professional development, method innovation and professional inspection. However, plans remained administrative; professional meetings were not regularly based on lesson study and classroom data. Monitoring and supporting the adjustment of teaching plans based on data were still limited, reflecting the lack of standardisation in data governance, evidence, feedback and decision-making.

2.4.3. Management of the learner element in Physics

Management of the learner element reached a fair level ($M = 3.75$; $SD = 0.858$) but lacked interconnection among orientation, task assignment, implementation, monitoring and feedback.

Management of self-study, task personalisation and student support on digital platforms was not regular; learning data had not been fully used to monitor progress, detect difficulties and adjust learning activities.

2.4.4. Management of the Physics learning environment

Management of the learning environment reached a fair level ($M = 3.74$; $SD = 0.901$), the lowest among the management contents. Infrastructure, equipment, learning resources and digital platforms received attention but developed unevenly; their exploitation was dispersed and lacked mechanisms for resource governance, shared repositories, digital safety, equal access and sustainable connection with external educational forces.

2.4.5. Factors influencing the management of teaching activities

Influencing factors were assessed at a fair level ($M = 3.81$; $SD = 0.886$). Main barriers belonged to three groups: implementation capacity of administrators, subject-group heads, teachers and students; conditions such as infrastructure, equipment, learning resources, class size and regional characteristics; and governance mechanisms for data, coordination, monitoring, feedback and adjustment that were not yet complete.

2.4.6. Results/effectiveness of management of Physics teaching activities

The effectiveness of Physics teaching-activity management reached a fair level ($M = 3.80$) but lacked sustainability. Pearson correlation analysis showed that management of the teacher element, learner element and learning environment all had positive, strong and statistically significant correlations with management outcomes/effectiveness ($p < 0.01$). This provides practical evidence for the integrated view of the three components and shows that the core limitation is not the absence of basic management functions, but the incomplete operation of the data-based governance layer.

2.5. General assessment of the current situation

Three notable strengths are: (1) the teacher, learner and learning-environment elements have changed positively and initially fit the interaction structure of the theoretical framework; (2) management has been implemented relatively fully according to basic functions and has gradually covered the three elements; and (3) many schools have begun to use LMS, SMAS, digital resources, simulations, online testing tools and some AI applications, creating a foundation for operating the integrated framework.

The main limitations are: innovation in teaching activities is not synchronous and lacks depth; the digital competence of teachers and students is uneven; STEM, experiments, simulations, self-study and personalisation are not stable. Management remains administratively oriented and has not shifted strongly towards process governance based on data; the monitoring-feedback-adjustment mechanism lacks interconnection. The learning environment and digital ecosystem remain dispersed and uneven in infrastructure, equipment, learning resources, data and coordination mechanisms.

The causes of these limitations are concentrated in the gap between innovation awareness and implementation capacity; uneven digital competence and data-governance thinking; professional development that is not closely connected with products and evidence; unstandardised processes for professional work, learning resources, data and feedback; and unequal regional conditions, infrastructure, equipment and resources among schools. A barrier-limitation-intervention matrix was developed to link the current situation directly with the system of measures in Chapter 3.

Conclusion of Chapter 2

Chapter 2 shows that upper secondary schools in the Central Highlands have a foundation of awareness and have implemented management functions for Physics teaching activities, but they have not yet formed a full data-based governance cycle. The core barrier is the lack of interconnection among teaching, learning and the learning environment; data, digital evidence and feedback have not become regular resources for planning, organisation, monitoring and adjustment. This is the practical basis for Chapter 3 to propose an integrated, focused system of measures suited to the conditions of the Central Highlands.

Chapter 3. MEASURES FOR MANAGING PHYSICS TEACHING ACTIVITIES IN UPPER SECONDARY SCHOOLS IN THE CENTRAL HIGHLANDS IN THE CURRENT CONTEXT

3.1. Principles for proposing measures

The system of measures is built on five principles: ensuring goal orientation; systemness and synchronisation; feasibility; effectiveness; and inheritance and development in accordance with state educational policies. These principles ensure that the measures align with the goal of competence development, address the barriers identified in the current situation and can be implemented according to the specific conditions of upper secondary schools in the Central Highlands.

3.2. Measures for managing the teacher element in Physics

Measure 1. Organising professional development in governance capacity and digital competence for administrators and Physics teachers regarding digital transformation and innovation-oriented governance thinking in schools

Measure 1 focuses on developing awareness, governance capacity, digital competence and the capacity to organise Physics teaching in a digital environment for administrators and teachers. Professional development is designed according to needs and linked with professional products, classroom data, learning resources, experiments/simulations, assessment and evidence of students' progress, thereby creating the human foundation for operating the remaining measures.

Measure 2. Directing Physics subject groups to build and adjust teaching plans based on digital data

Measure 2 standardises teaching plans according to competence-oriented objectives associated with DT; organises professional meetings through lesson study based on data; and establishes a process of monitoring, feedback and adjustment using data and digital evidence. Teaching plans are transformed from administrative distribution documents into tools of professional governance, linking objectives, activities, assessment, learning resources, experiments/simulations and learning-process data. Measure 2 holds the central role because it directly influences planning, professional meetings, method innovation, assessment, resource exploitation and data-based decision-making. It creates a closed cycle: planning - implementation - data collection - evidence analysis - feedback - adjustment, while connecting and activating the measures related to the teacher, learner and learning-environment elements.

Measure 3. Strengthening management of assessment in Physics teaching activities on digital platforms

Measure 3 aims to standardise objectives, matrices, specifications, item banks, rubrics, portfolios and digital products; organise formative assessment on suitable platforms; and analyse data to monitor the development of Physics competence, provide feedback to teachers and students, adjust teaching plans and support management decisions. Assessment thereby becomes a source of data for the quality-governance cycle, not merely a stage of confirming final results.

3.3. Measures for managing the learner element in Physics

Measure 4. Supporting the implementation of Physics learning activities linked with practice, projects and STEM tasks in a digital ecosystem

Measure 4 supports teachers in designing and implementing experiential activities, projects and STEM tasks linked with competence objectives, learning products and practical tasks; organising experiments, simulations, digital learning and self-study to create interest; and monitoring data, providing feedback and timely support to maintain motivation, adjust activities and improve Physics learning effectiveness.

Measure 5. Building a mechanism to promote the teacher's role in personalising Physics self-study based on digital data

Measure 5 establishes a mechanism for teachers to use data on competence achievement, errors, products and learning progress to differentiate tasks, select learning resources, guide, support and provide feedback appropriate to groups of students. The self-study process includes goal setting, planning, resource use, task performance, self-assessment and adjustment, thereby increasing learner autonomy and narrowing learning gaps.

Measure 6. Managing Physics pre-class self-study activities on digital platforms

Measure 6 standardises objectives, learning resources, guiding questions and pre-class products; monitors completion on digital platforms; and uses preparation data to organise effective classroom activities such as inquiry, experiments, simulations, discussion and problem solving. The measure helps form self-study habits and strengthens the link between pre-class learning, in-class learning and post-learning feedback.

3.4. Measures for managing the Physics learning environment

Measure 7. Proposing planning, investment and gradual completion of synchronous digital platforms for Physics governance

Measure 7 identifies the current situation, needs and priorities; develops a roadmap for planning and investing in digital platforms, equipment, connectivity and learning spaces according to the experimental nature of Physics; and ensures data interoperability, safety, equal access and effective exploitation. Investment follows the roadmap and conditions of each school, avoids dispersion and is linked to the goal of developing Physics competence.

Measure 8. Organising the effective exploitation and use of digital learning-resource systems for Physics teaching

Measure 8 organises digital repositories by topic, lesson process and competence-development requirements; establishes procedures for selection, appraisal, tagging, updating, sharing and evaluation of effectiveness. Resources, simulations, virtual experiments, software and accounts are governed as shared resources with assigned responsibilities and are exploited based on learning data.

Measure 9. Building a digital teaching environment and culture suited to the practice of Physics teaching in the Central Highlands

Measure 9 builds a safe, friendly, cooperative and responsible digital teaching environment; develops a culture of sharing learning resources and using data and AI with control; strengthens experiential learning, STEM, scientific research, career orientation and practice-based links suited to regional conditions. The learning environment is understood as a system of interactions and operational culture, not merely a set of equipment.

3.5. Relationship among the measures

The nine measures form a coherent whole corresponding to the three components of the Integrated Framework. The environment group provides the foundation, resources and culture; the teacher group organises, operates and innovates professional work; and the learner group influences self-study, interaction, feedback and competence development. The principal provides orientation, allocates resources and monitors; the vice-principal coordinates; the head of the subject group operates; and teachers implement and generate data from classrooms. Within this system, Measure 2 plays a central coordinating and activating role, while the other measures create conditions, provide support and extend impact.

3.6. Appraisal of necessity and feasibility

The appraisal involved 406 respondents from 40 upper secondary schools, including 191 administrators and 215 Physics teachers. All three groups of measures were rated as fairly necessary and fairly feasible; administrators' mean scores ranged from 3.87 to 3.89, while teachers' mean scores ranged from 3.67 to 3.74. Administrators prioritised the group of measures for managing the teacher element, while teachers prioritised the group for managing the learner element. In the teacher group, Measure 2 received the highest necessity rating from administrators and the highest feasibility rating from teachers. The results confirm contextual appropriateness and the need to implement the system of measures according to a roadmap.

3.7. Experiment of a management measure

Measure 2 was experimented in 10 upper secondary schools with 48 administrators and 59 teachers from Physics-Technology subject groups. The experiment had three stages: preparation from June 2023 to June 2024; implementation from June 2024 to June 2025; and evaluation from June 2025 to December 2025. It focused on standardising competence-oriented teaching plans associated with DT, conducting professional meetings through lesson study, and implementing a monitoring-feedback-adjustment process based on data and digital evidence.

T-test results for both teacher and administrator groups had $p < 0.05$, showing that pre-test/post-test differences were statistically significant. In the teacher group ($N = 59$), the overall mean score increased from 2.37 to 3.75 (+1.38); in the administrator group ($N = 48$), the overall mean score increased from 2.28 to 3.50 (+1.22), while dispersion decreased. Post-test ANOVA showed significant differences among management components: $F(5,282) = 2.750$; Sig. = 0.019; Partial $\text{Eta}^2 = 0.046$, reflecting a small-to-moderate effect size with practical significance.

The regression model was statistically significant with $F(5,42) = 125.780$; Sig. = 0.000; $R = 0.968$; $R^2 = 0.937$; and adjusted $R^2 = 0.930$. The results show a very strong relationship between the components of Measure 2 and management effectiveness, with the model explaining 93.7% of the variance in the outcome variable within the experimental data. The results should be interpreted within the scope of the one-group pre-test/post-test design and should not be treated as evidence of a universal model for all contexts.

The experiment showed that Measure 2 helped transform teaching plans from administrative records into instruments of professional governance; promoted Physics subject-group meetings through lesson study, classroom-data analysis and learning-resource sharing; and increased the use of LMS, SMAS, K12Online, assessment results, digital products and feedback as evidence for monitoring, support and adjustment. Measure 2 does not replace the other measures but plays the role of connecting, activating and coordinating the entire system from Measure 1 to Measure 9.

Conclusion of Chapter 3

Chapter 3 concretised the Integrated Framework into nine measures in three groups corresponding to the management of the teacher element, learner element and learning environment. The appraisal confirmed their necessity and feasibility. The experiment of Measure 2 showed statistically significant improvements in management effectiveness and clarified the operational mechanism based on plans, data, evidence and feedback. The results provide practical support for the scientific hypothesis within the research scope and confirm the central role of Measure 2 in activating the system of measures.

CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

1.1. Theoretical conclusions

The dissertation starts from the research gap in managing Physics teaching activities as an integrated whole among the teacher, the learner and the learning environment in a digital ecosystem. On the basis of SPTT, it clarifies Physics teaching activities as a system of pedagogical-technological-data interactions, in which experiments, simulations, observation, measurement, data processing, digital resources and online platforms play distinctive roles.

1.2. Practical conclusions

The survey results show that Physics teaching activities and their management in upper secondary schools in the Central Highlands have changed positively but are not yet synchronous or deep enough. The core barrier is not merely a lack of infrastructure or isolated digital competence, but the lack of interconnection among the teacher, the learner and the environment. Plans, professional meetings, assessment, data and feedback have not been operated as a closed governance cycle.

The key theoretical contribution is the Integrated Framework for the Management of Physics Teaching Activities with two interconnected layers: the management-function layer (planning, organisation, direction, inspection, evaluation and adjustment) and the governance-function layer (data, digital evidence, resource coordination, support, feedback and decision-making). The practical contribution is a system of nine measures directly linked to the identified barriers and suited to the conditions of upper secondary schools in the Central Highlands.

The appraisal results confirm that the system of measures is necessary and feasible. The experiment of Measure 2 provides initial evidence that when teaching plans are standardised, professional meetings are organised through lesson study, and data and evidence are used in monitoring, feedback and adjustment, management effectiveness tends to improve for both teachers and administrators. The results support the scientific hypothesis within the scope of the study and show that Measure 2 is the central activating point of the system.

2. Recommendations

2.1. For the Ministry of Education and Training

The Ministry should continue to improve guidance on organising teaching and managing teaching activities in digital environments; develop minimum standards for digital resources, simulation software, virtual experiments, digital teaching equipment and shared data repositories for Physics under the 2018 General Education Curriculum. It should also provide in-depth professional development for administrators and teachers in data-based governance, organisation of experiments/simulations, personalisation of learning activities and assessment using digital evidence, with attention to mountainous, remote and disadvantaged areas.

2.2. For Departments of Education and Training

Departments of Education and Training should coordinate resources according to the readiness levels of each locality and school; prioritise digital resources, shared laboratory equipment, simulation software and platforms capable of tracking learning data. They should organise Physics professional meetings by school clusters on teaching-plan development, lesson study, data exploitation, assessment and STEM, while supporting disadvantaged schools through appropriate roadmaps and avoiding one-size-fits-all models.

2.3. For principals of upper secondary schools

Principals should manage Physics teaching activities through an interconnected cycle of planning, implementation, monitoring, feedback and adjustment based on data. The focus should be on directing subject groups to standardise teaching plans, conduct professional meetings through lesson study, exploit LMS or digital learning portfolios, use existing equipment and simulations effectively, assign responsibilities clearly and use evidence to support teachers, monitor students and adjust teaching activities.

2.4. For Physics teachers

Physics teachers should actively organise competence-oriented teaching, strengthen experiments, simulations, digital resources, STEM and practice-based tasks, and create, store and use data from learning products, formative assessment and digital platforms to provide feedback, support and personalise learning activities. Participation in lesson-study-based professional meetings, resource sharing and classroom-data analysis should become a regular improvement activity.

Implementation roadmaps should match the readiness level of each school: first standardising professional processes, responsibilities, data and evidence; then developing digital competence, learning resources, experiments/simulations and data-based professional meetings; and finally expanding platforms, shared repositories, progress-monitoring systems and personalised learning. Scaling up should synchronise Measure 2 with the remaining measures and adjust to infrastructure, staff, student characteristics and regional conditio

LIST OF THE AUTHOR'S RESEARCH PUBLICATIONS

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