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MANAGING MATHEMATICS LEARNING OUTCOMES IN VIETNAMESE PRIMARY SCHOOLS UNDER THE CIPO MODEL

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Abstract

In Vietnam's ongoing competency-based curriculum reform, the management of learning outcomes in primary Mathematics plays a pivotal role in ensuring educational quality and accountability. Drawing on the CIPO (Context–Input–Process–Output) model, this conceptual paper focuses on the "Output" component as a feedback mechanism to improve teaching and learning in Mathematics. The article clarifies how output management should move beyond end-of-course testing to encompass the design of valid and reliable assessment criteria, the management of assessment processes, and the systematic use of assessment data for school improvement. First, it discusses the management of developing a standards-based set of assessment criteria for primary Mathematics outcomes that is valid, reliable, feasible, standardized, and continuously improved. Second, it examines the management of the assessment process, including planning, implementation, guidance for teachers, and monitoring and supervision to ensure objectivity, transparency, and alignment with the 2018 General Education Curriculum and relevant MOET regulations. Third, it addresses the management of evaluating students' mathematical competence development through learning progress records, student profiles, and the pedagogical use of assessment results to support diverse learners. Finally, the paper proposes a four-step procedure for school leaders to direct the development, validation, approval, and revision of output-based assessment criteria for primary Mathematics. The paper offers a comprehensive management framework that can support primary schools in Vietnam to implement outcome-based and competence-oriented Mathematics education more effectively.
Keywords: *CIPO model; learning outcomes; Mathematics education; competency-based assessment; educational management; primary school; Vietnam*

1. Introduction

In recent years, Vietnam has promoted a fundamental and comprehensive reform of general education towards competence development and quality assurance. The 2018 General Education Curriculum in particular

emphasizes learning outcomes in terms of students' core qualities and competencies, including mathematical competence at the primary level. In this context, managing learning outcomes – especially in key foundational subjects such as Mathematics – becomes a central task of school leadership and classroom practice. Within the CIPO (Context–Input–Process–Output) model, "Output" is not limited to final test scores but serves as a crucial basis for evaluating the effectiveness of the entire educational system and for feeding back information to improve Context, Input, and Process. Managing Mathematics learning outcomes in primary schools therefore involves: (a) managing the construction of assessment criteria for Mathematics outcomes; (b) managing the process of assessing learning outcomes according to competence-orientation; and (c) managing the evaluation of students' mathematical competence development over time.

This paper aims to systematize and internationalize a management framework for Mathematics learning outcomes in Vietnamese primary schools, grounded in the CIPO model and aligned with current national regulations on curriculum and assessment.

2. Literature Review

2.1. The CIPO model and educational quality

The CIPO (Context–Input–Process–Output) model conceptualizes schools as open systems in which educational quality is determined by the dynamic interaction among four components. Context refers to the broader sociocultural, economic, and policy environment; Input covers student characteristics, teacher qualifications, and material resources; Process encompasses teaching, learning, and school management activities; and Output represents students' learning outcomes and broader educational results (Scheerens, 1990). Originally developed in school-effectiveness research, the CIPO model has been widely used as an analytical and managerial framework to review and enhance educational quality at system, school, and classroom levels (Scheerens, 1990; Trần, 2020). In recent Vietnamese studies, CIPO has been applied to manage experiential learning, career guidance, and teacher professional development, confirming its suitability for quality assurance under competency-based reform (Trần, 2020; Vũ & Nguyễn, 2024). Within this framework, Output management is not simply the final step but also a key feedback mechanism. Analysing learning outcomes in Mathematics allows school leaders to diagnose weaknesses in Context, Input, and Process and to design targeted interventions to improve teaching and learning (Scheerens, 1990; Vũ & Nguyễn, 2024).

2.2. Outcome-based and competency-based education

Outcome-based education (OBE) advocates that all curriculum, teaching, and assessment decisions should be driven by clearly defined learning outcomes that students must demonstrate at the end of a course or program (Spady, 1994). Spady (1994) emphasizes that an outcome-based system "starts with a clear picture of what is important for students to be able to do" and then organizes curriculum, instruction, and assessment to ensure that this learning actually occurs. Recent reviews highlight both the potential and the challenges of OBE, noting that poorly designed outcome frameworks or purely bureaucratic implementation can reduce OBE to a compliance exercise rather than a genuine improvement strategy (Naskar, 2023). Consequently, robust management of learning outcomes – including the design of valid criteria, appropriate assessment processes, and the meaningful use of data – is critical for realizing the benefits of OBE in school practice (Naskar, 2023; Spady, 1994). Competency-based education shares the same focus on demonstrable performance but frames outcomes explicitly as integrated competencies (knowledge, skills, and attitudes) rather than discrete content units. Many countries, including Vietnam, have moved towards competency-based curricula in which learning outcomes are articulated as competency standards and performance descriptors, providing a foundation for output-oriented management in subjects such as Mathematics (Ministry of Education and Training, 2018).

2.3. Assessment of learning outcomes and formative assessment

Assessment is the primary mechanism through which learning outcomes are op-

erationalized and monitored. International research shows that formative assessment – assessment for learning – has a particularly strong impact on student achievement when it provides timely, descriptive feedback and involves students actively in the assessment process (Black & Wiliam, 1998). They seminal work demonstrates that innovations designed to strengthen classroom assessment can yield substantial learning gains across subjects and grade levels.

In Mathematics, high-quality assessment is characterized by alignment with mathematical goals, elicitation of rich evidence of student thinking, and the use of this evidence to adjust instruction. The National Council of Teachers of Mathematics (NCTM, 2014) stresses that assessment should be coherent with ambitious learning goals and core teaching practices such as posing purposeful questions, supporting productive struggle, and using evidence of student thinking to inform instruction (NCTM, 2014). From a management perspective, these findings imply that managing Mathematics learning outcomes cannot focus solely on summative testing. Instead, school leaders must ensure that teachers are equipped to integrate formative and summative assessment, use diverse assessment tools (tests, performance tasks, projects, portfolios), and interpret assessment data in ways that support students' ongoing development in mathematical competence (Black & Wiliam, 1998a; NCTM, 2014).

2.4. Mathematics learning outcomes in the Vietnamese curriculum

Vietnam's 2018 General Education Curriculum defines Mathematics as a core subject with the dual mission of developing both general competencies and subject-specific mathematical competencies. The Mathematics curriculum identifies key components such as mathematical thinking and reasoning, modelling, problem solving, mathematical communication, and the use of tools and resources (Ministry of Education and Training, 2018). Recent Vietnamese studies further elaborate these components, for example by clarifying mathematical communication competence and by exploring instructional approaches that can effectively develop such competencies in secondary education (Nguyễn & Nguyễn, 2022). These works underline that competence development must be monitored through carefully designed learning outcomes and assessment criteria that capture not only procedural skills but also conceptual understanding, reasoning, communication, and real-world application (Ministry of Education and Training, 2018; Nguyễn & Nguyễn, 2022). In this policy context, managing Mathematics learning outcomes at primary level involves translating national competency standards into school-level and classroom-level criteria, ensuring consistency across grades, and using assessment evidence for teaching improvement and student support (Ministry of Education and Training, 2018).

2.5. Implications for managing mathematics learning outcomes under the CIPO model

Synthesizing the above theoretical and policy perspectives, the management of Mathematics learning outcomes in primary schools under the CIPO model should be grounded in three principles. *First*, **systemic alignment**: Output (learning outcomes and assessment criteria) must be aligned with national competency standards in Mathematics and coherently linked to Context, Input, and Process factors such as school resources, teacher professional development, and classroom pedagogy (Ministry of Education and Training, 2018; Scheerens, 1990; Trần, 2020). *Second*, **evidence-informed improvement**: Assessment data should be used formatively to diagnose students' strengths and weaknesses, to adjust instruction, and to inform school-level decisions about curriculum, teacher support, and resource allocation, rather than merely to rank or classify students (Black & Wiliam, 1998; NCTM, 2014). *Third,* **context-sensitive quality management:** Adapting the CIPO model to the Vietnamese primary context requires school leaders to design management measures – such as the development of standardized yet flexible assessment criteria – that respect local conditions while ensuring fairness and comparability across classes and schools (Scheerens, 1990; Trần, 2020; Vũ & Nguyễn, 2024).

These principles provide the theoretical foundation for the subsequent sections of the paper, which focus on the concrete management of assessment criteria, assessment processes, and the evaluation of students'

mathematical competence development in primary schools.

3. Research Results

3.1. A Management Measure: Directing the development of Output-based criteria for primary mathematics

Building on the above analysis, this section proposes a concrete managerial measure: a four-step procedure for principals to direct the development of output-based assessment criteria for primary Mathematics.

Step 1 – Establishing a specialized committee

The principal establishes a specialized committee to develop the criteria. The committee typically includes: Principal as Chair; Vice-principals in charge of academic affairs as vice-chairs; Heads of subject departments and key Mathematics teachers as members. The principal provides overall orientation and approves the final criteria, while other members engage directly in drafting and technical development.

Step 2 – Directing the construction of criteria

The principal divides the committee into sub-groups, each responsible for a particular grade level. Each sub-group has a leader, a secretary, and members. The work involves three main stages:

Capacity building and legal basis analysis: Organizing professional seminars to deepen teachers' understanding of output-based assessment in primary Mathematics; Analysing legal documents and curriculum frameworks concerning assessment and Mathematics teaching (e.g., national curriculum, MOET circulars, textbooks, and related resources).

Drafting the criteria: Based on required outcomes in the 2018 curriculum, group leaders assign members to develop criteria, indicators, and performance levels for knowledge, skills, qualities, and competencies in Mathematics; Each group drafts a set of criteria for its assigned grade level.

Appraising and standardizing the criteria: The principal collects feedback from external experts, school leaders, and practising primary teachers; Comments are synthesized and sent back to experts for further refinement through multiple rounds if necessary; Pilot implementation in selected classes and schools is carried out to gather empirical data and identify practical challenges in using the criteria; Based on feedback and pilot results, the committee revises and standardizes the criteria.

Step 3 – Approval and implementation

The principal formally reviews and approves the criteria for each grade level. Implementation measures include: Intensive training for all teachers on using the criteria, designing aligned assessment tools, and documenting students' progress; Official communication of the criteria to teachers, students, and parents to ensure shared understanding and cooperation.

Step 4 – Evaluation and continuous revision

The principal regularly monitors how teachers apply the criteria in teaching and assessment. Periodic evaluations of the criteria's effectiveness should be organized, combining: Teacher, student, and parent feedback; Analysis of student performance trends; Findings from internal supervision and external reviews. Based on these data, the principal instructs the committee to revise and update the criteria so that they remain relevant, feasible, and effective in promoting students' mathematical competence.

3.2. Managing the implementation of the assessment process based on the Mathematics learning outcomes in primary schools

Establishing and operating an assessment process aligned with the Mathematics learning outcomes in primary schools is an important basis for measuring teaching quality and adjusting teaching content, methods, and organizational forms towards the development of students' qualities and competences. This process can be managed through the following steps:

Step 1. Planning assessment based on the learning outcomes framework

The principal directs the professional teams to develop periodic assessment plans (after each topic, mid-term, end-of-term) appropriate to the curriculum and each grade level. The plan must clearly specify: content and competences to be assessed, assessment forms, assessment tools (tests, observation checklists, rubrics, rating scales, etc.), and

link each criterion to specific content and performance level requirements.

Step 2. Training and guiding teachers to use the criteria

The principal develops a training plan with clear objectives, time, content, target groups, and trainers. Training content focuses on: correctly understanding the Mathematics learning outcomes, the structure and meaning of each criterion, how to select methods and construct appropriate assessment tools, and how to record and use results to provide feedback. Training should combine theory with practice through case analysis and designing rubrics and observation forms for specific topics. After training, the school organizes professional workshops, experience sharing, and appoints core teachers to support colleagues.

Step 3. Designing, piloting, and standardizing assessment tools

Teachers and professional teams select assessment methods suitable for each criterion (written tests, products, observation, projects, etc.). From there, they design corresponding tools: test papers, observation sheets, rubrics, rating scales that ensure objectivity, user-friendliness, and suitability for students' developmental characteristics. Tools must be piloted with a small group of students to adjust difficulty, discrimination, and wording before large-scale implementation. Finally, the tools are standardized and adopted across teams and the whole school to ensure that data are comparable between classes, grades, and over time.

Step 4. Collecting assessment evidence during teaching

Teachers identify the types of evidence to be collected (student work, products, observation records, videos, self-assessment, peer-assessment, etc.). Evidence collection is integrated naturally into teaching activities: group work, presentations, application tasks, small projects, ensuring continuity, diversity, and alignment with the learning outcomes criteria. Evidence should be recorded together with specific comments and feedback for students.

Step 5. Coding, analyzing, and using assessment results

Teachers record results by criterion on rubrics or tracking sheets, using clear qualitative/quantitative scales. Data are entered into summary tables (Excel or school management software) to calculate the percentage of students meeting each criterion, average scores by criterion, class, and grade. Professional teams and school leaders analyze trends, strengths and weaknesses, and compare results across assessment periods to propose adjustments in teaching plans, remedial activities, differentiation, and competence development support.

Step 6. Storing assessment records and monitoring implementation

Assessment records (tests, observation sheets, rubrics, summary tables, sample student work, minutes of professional meetings, etc.) are systematically stored in paper and/or digital formats with secure access. The school leadership and professional teams conduct regular monitoring of planning, tool use, and record keeping, while providing timely guidance and support to teachers. Through this, the assessment process based on learning outcomes is stabilized and effectively implemented, thereby improving the quality of Mathematics teaching in primary schools.

3.3. Discussion

The proposed framework demonstrates that managing Mathematics learning outcomes in primary schools under the CIPO model requires an integrated approach that connects assessment criteria, assessment processes, and the use of assessment evidence for improvement (Scheerens, 1990; Trần, 2020; Vũ & Nguyễn, 2024). Output management cannot be treated as a separate technical activity but must be embedded in broader school management and professional development strategies that align Context, Input, Process, and Output in a coherent quality cycle (Scheerens, 1990). For policy makers, the framework highlights the need for clear national guidance on competency-based, outcome-oriented assessment in Mathematics, along with training programmes that build school leaders' capacity in assessment management (Ministry of Education and Training, 2018; Spady, 1994; Naskar, 2023). Such guidance should explicitly connect the 2018 General Education Mathematics Curriculum and its competency structure with practical tools for school-level output management,

including standards-based criteria, formative assessment strategies, and data-use protocols (Ministry of Education and Training, 2018; Nguyễn & Nguyễn, 2022). For school leaders, the four-step procedure for directing the development of output-based criteria provides a practical roadmap for operationalizing national policies at school level within the CIPO framework (Scheerens, 1990; Trần, 2020). By organizing specialized committees, piloting and standardizing criteria, and institutionalizing periodic review, principals can ensure that assessment in Mathematics is not merely a compliance requirement but a driver of instructional improvement. For teachers, systematic support in using competency-based criteria, diverse assessment tools, and classroom-embedded formative assessment can enhance both their assessment literacy and everyday practice (Black & Wiliam, 1998, NCTM, 2014). When teachers are able to interpret evidence of students' mathematical thinking and to adjust instruction accordingly, assessment becomes an essential part of teaching for understanding rather than a separate, end-of-term activity. This is particularly important in primary Mathematics, where early experiences with problem solving, reasoning, and communication lay the foundation for students' long-term engagement with the subject (Ministry of Education and Training, 2018; Nguyễn, 2022).

Managing learning outcomes in primary Mathematics through the lens of the CIPO model emphasizes the centrality of the Output component as both an end and a new beginning in the quality cycle of school improvement (Scheerens, 1990; Trần, 2020). By ensuring that assessment criteria are valid, reliable, feasible, standardized, and continuously improved; by managing assessment planning, implementation, and supervision; and by using assessment data to support students' mathematical competence development, primary schools can better fulfil the goals of competency-based education reform in Vietnam (Ministry of Education and Training, 2018; Spady, 1994; Naskar, 2023).

The four-step managerial measure for directing the development and implementation of output-based criteria provides a concrete tool for school leaders to translate policy into practice in Mathematics. It operationalizes key principles from outcome-based and competency-based education – clear learning outcomes, aligned assessment, and evidence-informed decision-making – within the specific context of Vietnamese primary schools (Spady, 1994; NCTM, 2014; Vũ & Nguyễn, 2024).

Future empirical studies could examine the impact of this framework on student outcomes and teacher assessment practices across diverse school contexts. For example, longitudinal and multi-site research could investigate how the use of standardized, yet context-sensitive Mathematics output criteria affects students' development in mathematical thinking, problem solving, and communication (Ministry of Education and Training, 2018; Nguyễn, 2022). Such evidence would further refine the proposed management model and contribute to the broader international discussion on how CIPO-based quality management and formative assessment can support high-quality Mathematics education for all students (Black & Wiliam, 1998).

4. Conclusion

Managing learning outcomes in primary Mathematics through the lens of the CIPO model emphasizes the centrality of the Output component as both an end and a new beginning in the quality cycle. By ensuring that assessment criteria are valid, reliable, feasible, standardized, and continuously improved; by managing assessment planning, implementation, and supervision; and by using assessment data to support students' mathematical competence development, primary schools can better fulfil the goals of competence-based education reform in Vietnam.

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