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A SYSTEMATIC RESEARCH AGENDA ON PERFORMANCE-BASED ASSESSMENT OF STUDENTS' APPROACHES TO LEARNING: THE APPROACH-IN-PROCESS TEST VERSION 2 AND ITS SCORING GUIDE (2022-2025)

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Abstract:
Students' approaches to learning have historically been assessed through self-report questionnaires, limiting the analysis of learning processes in authentic educational settings. This article presents a systematic research agenda (2022-2025) conducted by LAICO (Laboratory for Cognitive Architecture Mapping (LAICO) that addresses this methodological gap. The Approach-in-Process Test version 2 (TAEPv2) is the first standardized performance-based instrument to psychometrically evaluate students' approaches to learning through open-ended responses that require applying deep-learning behaviors to academic content. Its Scoring Guide structures the evaluation of these responses while requiring teachers to engage in systematic conceptual mapping of their instructional content. Thirteen studies demonstrate that the combined use of the Test and Guide generates consistent positive educational outcomes: it promotes reflection on teaching practice, enhances student self-assessment, and supports the design of pedagogical activities that directly intervene in learning processes. Applied across diverse academic subjects and educational contexts, the instruments have demonstrated versatility and consequential validity. This research agenda exemplifies how LAICO's integration of psychometric expertise, methodological innovation, and commitment to performance-based assessment created the conditions for instruments that assess complex learning constructs while simultaneously strengthening teaching practice. Ongoing research includes full psychometric validation and a randomized controlled trial examining the causal impact of pedagogical interventions based on the Test and Guide.

Keywords: psychopedagogical assessment, students' approaches to learning, performance-based test, teacher education

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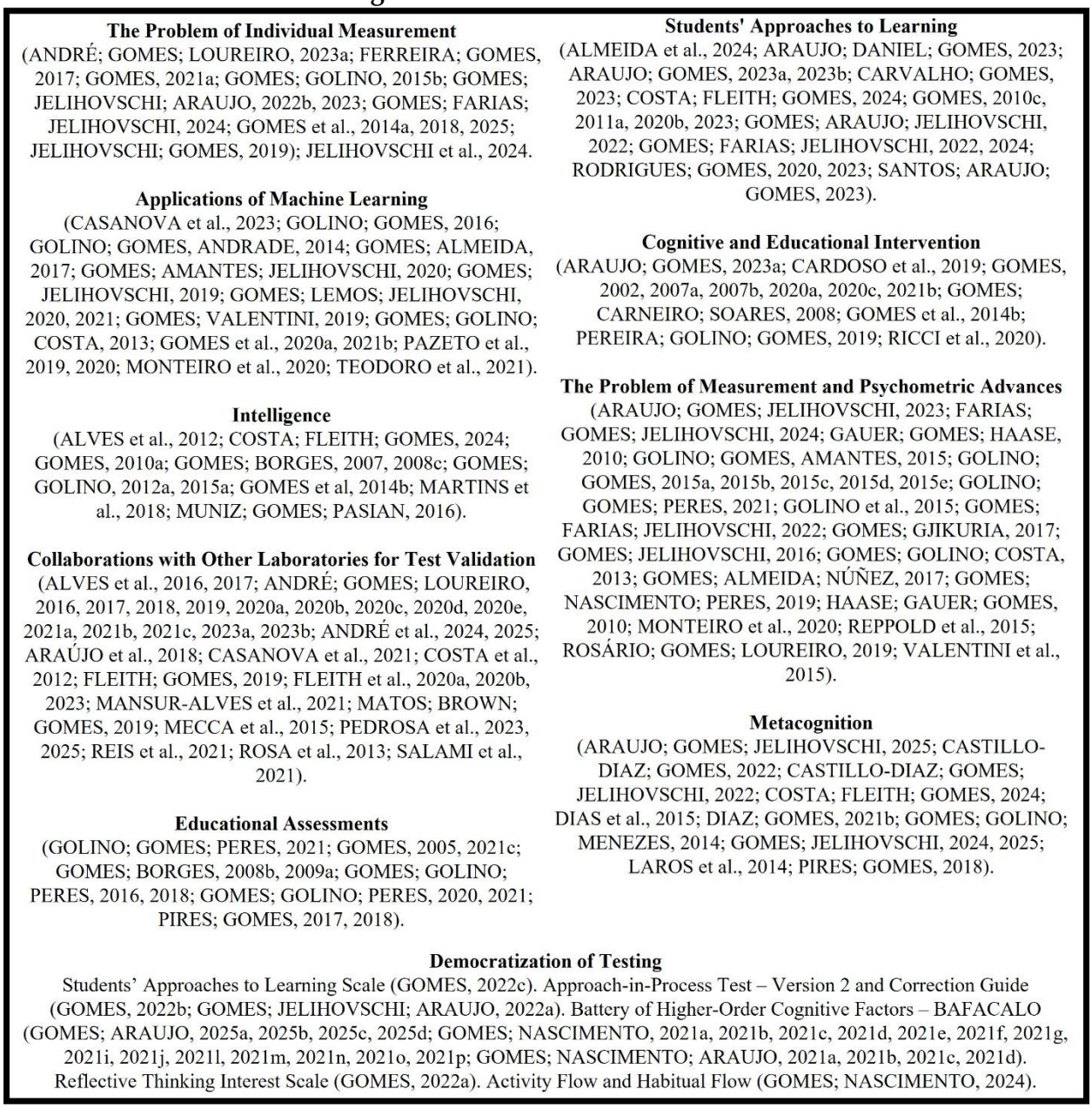
1. Introduction

The Laboratory for Cognitive Architecture Mapping (LAICO) was founded in 2009 as a center of excellence for teaching and research. Its focus was the validation of theories and psychoeducational tests. From this foundation, the laboratory first developed intelligence tests and conducted studies on cognitive abilities and cognitive intervention programs. At the same time, its agenda expanded to constructs such as academic motivation, students' approaches to learning, and metacognition. To deal with these validation issues, LAICO advanced methodological research on measurement problems, including the development of scoring rubrics for open-ended responses, applied psychometric techniques in innovative ways to validate performance-based instruments, and applied machine learning algorithms to address measurement and validation issues, support construct validation, refine the measurement of the individual, and enable predictive modeling (Figure 1). This methodological investment enabled predictive studies in education and fostered collaborations for theory and test validation. During the 2010s, LAICO also initiated a research agenda on performance-based assessments in fields that had relied mainly on self-report measures (Figure 2). The first domain was metacognition, followed later by the theory of students' approaches to learning, which marked a paradigm shift in assessment practices. This convergence of psychometric expertise, methodological innovation, and commitment to performance-based measurement created the conditions for a sustained research agenda on instruments that could assess complex learning constructs through authentic student responses.

Building on this foundation, LAICO developed the Approach-in-Process Test version 2 (TAEPv2) and its Scoring Guide as part of a systematic research agenda (2022-2025) that exemplifies the laboratory's methodological trajectory. Students' approaches to learning have historically been assessed through self-report questionnaires. TAEPv2 represents a methodological advance as the first standardized performance-based instrument to psychometrically evaluate students' approaches to learning through open-ended responses that require applying deep-learning behaviors to the academic content taught by the teacher. The Scoring Guide has been applied in different academic subjects and contexts. Within LAICO's broader portfolio, this test highlights the dual mission of democratizing assessment tools and advancing psychoeducational construct research.

Figure 1: Research Areas of LAICO



The following sections present 13 studies conducted between 2022 and 2025 with TAEPv2 and its Scoring Guide. Eleven were published in scientific journals and two were presented at scientific events. These studies provide evidence of consequential validity, as the combined use of the test and the Guide has consistently generated positive educational outcomes: it promotes reflection on teaching practice, enhances student self-assessment, and supports the development of pedagogical activities that directly intervene in learning processes. Designed for use across diverse academic contents, TAEPv2 and its Scoring Guide have also demonstrated versatility and consistency when applied in varied teaching contexts.

Figure 2: Examples of Tests Developed by LAICO

1) Learning Approaches Scale
[assesses students' aproaches to learning; self-report test] (GOMES, 2010c, 2011a, 2013; GOMES; FARIAS; JELIHOVSCHI, 2022; GOMES; GOLINO, 2012c, 2014; GOMES et al., 2011).

2) Approach-in-Process Test Version 2 and Correction Guide
[assesses learning approaches in academic content; performance-based test] (ALMEIDA et al., 2024, 2025; ARAUJO; GOMES, 2023a, 2023b; ARAUJO; DANIEL; GOMES, 2023; CARVALHO; GOMES, 2023; GOMES, 2023; GOMES; ARAUJO; JELIHOVSCHI, 2022; RODRIGUES; GOMES, 2023; SALLUM; GOMES; ASSIS, 2025; SANTOS; ARAUJO; GOMES, 2023) and its expired version (GOMES; RODRIGUES, 2021).

3) Students' Learning Approach Test – Identification of Thinking in Texts (SLAT-THINKING 3)
[assesses learning approaches in argumentative reading; performance-based test] and its expired versions (GOMES, 2021d; GOMES; ARAUJO; JELIHOVSCHI, 2023; GOMES; LINHARES, 2018; GOMES; NASCIMENTO, 2021h, 2021k, 2022; GOMES et al., 2020b, 2021c).

4) The Learning Approaches Test for Video Game Players – LAT-VIDEO-GAME
[assesses deep and surface learning approaches of videogame players; self-report test] (GOMES; ARAUJO; JELIHOVSCHI, 2020).

5) The Learning Approaches Test for Video Game Players-Two Factors – LAT-VIDEO-GAME-2F
[assesses deep and surface learning approaches of videogame players; self-report test] (ARAUJO; GOMES, 2024).

6) Battery of Higher-Order Cognitive Factors – BAFACALO
[18 intelligence tests that assess, through performance, the general factor and the following broad cognitive abilities from the Cattell-Horn-Carroll model: fluid intelligence, crystallized intelligence, visuospatial ability, fluency, short-term memory, and cognitive speed] (ALVES et al., 2012; GOLINO; GOMES, 2014; GOMES, 2010a, 2010b, 2011b, 2012b; GOMES; BORGES, 2009b, 2009c; GOMES et al., 2014a; GOMES; MARQUES; GOLINO, 2014).

7) Metacognitive Monitoring Test – MMT
[assesses metacognition; performance-based test] (CASTILLO-DIAZ; GOMES, 2022; GOLINO; GOMES, 2011; GOMES; ARAUJO; CASTILLO-DÍAZ, 2021; GOMES; GOLINO; MENEZES, 2014).

8) School Aspirations Questionnaire
[assesses school aspirations; self-report test] (GOMES; GJIKURIA, 2018).

9) Activity-Specific Flow Test
[assesses flow experienced by the individual during an activity; self-report test] (GOMES; NASCIMENTO, 2024).

10) Routine Flow Test
[assesses flow experienced by the individual during an activity; self-report test] (GOMES; NASCIMENTO, 2024).

11) Meta-Text Test
[assesses metacognition for planning, monitoring, and judgment; performance-based test] (ARAUJO; GOMES; JELIHOVSCHI, 2025; CASTILLO-DIAZ; GOMES, 2023; CASTILLO-DIAZ; GOMES; JELIHOVSCHI, 2022; DIAZ; GOMES, 2021a, 2021b).

12) Inductive Reasoning Test – Second Revision (IRT-SR)
[assesses intelligence through performance] (GOMES et al., 2021a, 2023) and its expired version (GOLINO; GOMES, 2012, 2019; GOLINO et al., 2014).

13) Personality Characteristics Inventory
[assesses personality; self-report test] (GOMES, 2012a; GOMES; GOLINO, 2012b; PINHEIRO; GOMES; BRAGA, 2009).

14) Procrastination Mechanisms Questionnaire
[assesses procrastination; self-report test] (GOMES; ROZENBERG, 2021, GOMES; ROZENBERG; ARAUJO, 2023).

15) Thinking Styles Inventory
[assesses thinking styles; self-report test] (GOMES; MARQUES, 2016; GOMES; MARQUES; GOLINO, 2014).

16) Self-Referent Academic Cognitions Scale
[assesses self-concept, self-efficacy, self-esteem, and value in academic contexts; self-report test] (COSTA; GOMES; FLEITH, 2017).

17) Experiential Ability Test
[assesses experiential capacity; performance-based test] (SILVEIRA; GOMES, 2014; SILVEIRA et al., 2012).

18) Students' Beliefs about Teaching and Learning – CREA
[assesses students' perceptions about the teaching-learning process; self-report test] (ALVES et al., 2012; GOMES; BORGES, 2008a).

19) Reflective Thinking Interest Scale
[assesses interest in reflective thinking; self-report test] (GOMES; JELIHOVSCHI; ARAUJO, 2022c).

- **Study 1: Theoretical Foundations and Methodological Innovation of the Approach-in-Process Test Version 2**

GOMES, C. M. A.; JELIHOVSCHI, E. G.; ARAUJO, J. Presentation of the Approach-In-Process Test (version 2). **European Journal of Education and Pedagogy**, v. 3, n. 4, p. 81-91, 2022a. Available at: https://doi.org/10.24018/ejedu.2022.3.4.402.

This article introduces the Approach-in-Process Test Version 2 (TAEPv2), developed by LAICO (Laboratory for Cognitive Architecture Mapping) to address a methodological gap in students' approaches to learning theory. Before this instrument, no standardized performance-based test was available to assess these approaches. Self-report instruments limit the analysis of learning processes in authentic educational

settings, constraining both research on students' approaches and the evaluation of pedagogical interventions.

The TAEPv2 addresses this limitation by measuring students' approaches to learning through actual performance, specifically by evaluating six deep-approach behaviors within a given academic content. The test comprises six questions, each with four items. The first item asks whether the student is able to perform the deep-approach behavior, with response options "yes" or "no." If the answer is "yes," the student proceeds to the subsequent items; if "no," the student answers only item 4. Item 2 provides space for the student to write a response demonstrating the deep-approach behavior in the subject matter. Item 3 asks the student to evaluate the influence of classroom instruction on the deep-approach behavior. Item 4 asks the student to assess how frequently this behavior occurs in their academic life. The only exception to this structure is Question 4, in which item 1 does not require self-evaluation but instead directly asks whether the student actually performed the behavior of deepening the taught content.

Although the original publication used a 0–2 scoring system for item 2, a binary system (0–1) was later adopted. This modification eliminated redundancy with item 1 and improved psychometric precision. The administration of the Approach-in-Process Test version 2 requires a standardized Scoring Guide, co-developed with the test, to evaluate each of the six open responses from item 2 and convert them into binary scores (0 or 1). Summing these scores yields a single performance measure of the deep approach to learning for the academic content. LAICO directly supervises teachers in the use of this guide to ensure scoring reliability.

- **Study 2: the Approach-in-Process Test Version 2 as an Optimal Framework for Self-assessment in Educational Practice**

ARAUJO, J.; GOMES, C. M. A. O Teste Abordagem-em-Processo Versão 2 possui potencial pedagógico para aprimorar a autoavaliação do estudante. **Synesis**, v. 15, n. 4, p. 36-45, 2023a. Available at: https://seer.ucp.br/seer/index.php/synesis/article/view/2695.

This article investigates the pedagogical potential of the Approach-in-Process Test Version 2 as a tool to enhance student self-assessment. The authors start from the premise, grounded in comprehensive literature reviews, that self-assessment is essential for developing self-regulated learning and metacognition. However, they argue that improper implementation of this process may compromise its benefits. A key problem identified is leaving students unsupported during self-evaluation, which tends to induce biases such as the Dunning-Kruger effect and inaccurate judgments. Conversely, they also argue that mere support is insufficient. The pedagogical guidance provided must target learning processes, not just final products.

The authors demonstrate that the Approach-in-Process Test Version 2 qualifies as a high-quality self-assessment tool because it operationalizes four fundamental criteria:

(1) objective parameters, (2) external feedback centered on the active learner, (3) self-evaluation anchored in the product, and (4) calibration of self-assessment.

The analysis focuses on how the test meets each criterion and articulates the concepts and procedures that support this proposition.

a. First criterion

The test provides objective parameters through structured items capturing deep-learning approach behaviors, such as describing concepts in one's own words, generating examples, creating explanatory diagrams, identifying conceptual errors, and proposing reflective exercises. These items serve as explicit references for students and teachers, enabling both to analyze and monitor learning processes consistently and collaboratively. Objectivity is further ensured by requiring teachers to develop predefined answer keys, establishing clear criteria for performance analysis.

b. Second criterion

This emphasizes external feedback grounded in the notion of the student as an active agent. The authors employ a mountain-climbing analogy to illustrate how responding to the test serves as immediate external feedback, fostering self-awareness of one's learning processes. Additionally, teacher mediation and peer dialogue create a chain of qualitative external feedback, expanding student reflection and strengthening engagement in their own learning pathways.

c. Third criterion

The test anchors the self-assessment process in an objective product: the instructional content defined by the teacher. All student tasks and judgments produced in the test are directly related to this content, preventing distraction and reinforcing the pedagogical function of self-assessment. Thus, the test maintains a dual focus on processes and products, ensuring self-reflection enhances subject-specific learning.

d. Fourth criterion

Calibration of self-assessment highlights the importance of students' reflection on the accuracy and quality of their judgments. The test supports this process by enabling students to compare their performance expectations with the instructor's feedback. Such comparisons encourage them to reevaluate the foundations of their judgments, identifying factors that undermine accuracy, such as flawed beliefs, conceptual misunderstandings, inadequate prior knowledge, or insufficient skills. Calibration is thus a crucial mechanism for refining self-perception and deepening understanding of one's learning.

The authors contend that the test promotes higher-quality self-assessment by structuring the student experience around objective, dialogic, and pedagogically actionable elements. Consequently, they conclude that the Approach-in-Process Test Version 2 holds dual value: as both a diagnostic instrument and a tool for improving learning processes. They hope this article encourages high school and university teachers to adopt the test for pedagogical practice.

- **Study 3: the Approach-in-Process Test Version 2 as a Framework for Identifying Superficial Learning Approaches through Error Categorization, Enabling Process-centered Pedagogy**

ALMEIDA, A. M. S.; RODRIGUES, M. N. S.; GOMES, C. M. A.; ASSIS, I. S. D. Pedagogy Focused on Learning: Assessment of Error Processes. **Preprint**, 2025. Available at: https://doi.org/10.20944/preprints202505.0975.v1.

This study addresses systemic challenges in Brazilian high schools, including high dropout rates and low academic performance, as evidenced by assessments such as PISA. The authors link these issues to a disconnect between curricula and students' real-life contexts, which limits schools' capacity to foster holistic development, citizenship, and essential competencies. Although reforms such as Brazil's 2022 New High School policy reposition students as active agents and encourage deeper learning, persistent difficulties remain in achieving tangible improvements.

The authors argue that instruments capable of directly assessing students' learning processes can support more effective pedagogical interventions. They justify using the Approach-in-Process Test Version 2, a performance-based test grounded in the theory of students' approaches to learning, to empirically evaluate how students engage with academic content. This theory distinguishes deep learning approaches, characterized by meaningful engagement and qualitative content interaction, from superficial approaches involving low engagement and ineffective comprehension strategies.

Unlike traditional self-report instruments, the test evaluates performance across six deep-learning behaviors: defining concepts in one's own words, generating concrete examples, constructing conceptual diagrams, elaborating on content in depth, identifying misconceptions, and designing challenging exercises. Responses are scored using a predefined Scoring Guide that specifies conceptual expectations. Crucially, the test also identifies and categorizes students' errors, providing qualitative data on specific learning difficulties. These errors represent superficial learning approaches that hinder knowledge acquisition.

The research involved 71 students from a public high school in a socioeconomically vulnerable region of Minas Gerais. The school's average score on Brazil's National High School Exam is 474.71, and teachers report widespread disengagement, behavioral issues, and learning gaps. Participants were students aged 14-18 from grades 10-11. Data were collected during the first semester of 2023, with the test administered in classrooms over 50 minutes for diagnostic purposes and no prior pedagogical intervention related to the assessed behaviors.

Data analysis followed four integrated stages. First, the lead researcher and the course teacher jointly evaluated student responses for conceptual accuracy and alignment with the target behaviors. Second, the lead researcher reviewed this analysis with a test specialist to consolidate the identified errors. Third, error categorization was developed recursively through collaborative analysis of responses selected as error exemplars. Finally, category reliability was verified through independent assessment by

the specialist on 17 randomly sampled responses, achieving 95.65% inter-rater agreement.

Results revealed that only 2.35% of responses met the deep-learning criteria (168 of 426 possible responses). The 389 errors were categorized into ten types and grouped hierarchically by frequency. The first group, accounting for 75% of errors, included Incapacity Judgment (students declaring their inability to perform tasks) and Common Sense (relying on personal beliefs rather than taught concepts, e.g., defining adolescence as "the main phase of social circle expansion" while disregarding socio-historical content). These errors indicate severe pedagogical gaps, especially in basic tasks.

The second group (19% of errors) comprised Fragmented Concepts (disconnected lists of topics), Procedural Misunderstanding (unclear task execution), and Concrete-Abstract Confusion (inability to distinguish examples from definitions). The third group (6%) included rarer errors such as Depth-Information Confusion, Conceptual Misinterpretation, Information Repetition, Difficulty-Comprehension Confusion, and Incomplete Conceptual Definition, each revealing nuanced learning obstacles.

In the discussion, the authors contend that error categorization provides objective foundations for precise interventions. Incapacity judgments and common-sense errors call for activities to strengthen foundational skills, while the test proves effective for mapping cognitive and metacognitive gaps to support process-centered pedagogy. Despite limitations such as a small sample size and single-discipline focus, the findings contribute to high school reform debates, particularly regarding adaptive assessment. Future research should explore cross-disciplinary test applications and examine the impact of error-based interventions on the transition from superficial to deep learning approaches.

- **Study 4: Rationale and Structure of the Correction Guide for the Approach-in-Process Test Version 2: Assessing Learning Approaches through Student Performance**

GOMES, C. M. A.; ARAUJO, J.; JELIHOVSCHI, E. G. Presentation of the Correction Guide for the Approach-in-Process Test Version 2 and its application in the content of "We Don't Have Direct Access to Reality". **European Journal of Education and Pedagogy**, v. 3, n. 6, p. 112-123, 2022. Available at: https://doi.org/10.24018/ejedu.2022.3.6.497.

The Laboratory for Cognitive Architecture Mapping at the Federal University of Minas Gerais has developed a research program focused on designing performance-based tests to measure approaches to learning. The Approach-in-Process Test Version 2 is part of this initiative. This test assesses approaches to learning in academic settings by combining self-report items with performance-based components. Because the performance items (type 2) are open-ended, a Scoring Guide proved essential to assist instructors in evaluating responses as correct or incorrect.

This article presents, for the first time, the Scoring Guide for the Approach-in-Process Test Version 2, detailing its structure and demonstrating its practical application

to specific university-level content. The guide comprises five integrated sections. The first section defines the instructional content to be evaluated. The second section selects and names core concepts, limiting itself to fundamental abstractions while avoiding peripheral elements. The relevance of selection follows the criterion of "conceptual gravitation," whereby non-core concepts orbit central ones, enabling structured content organization. The third section contextualizes the content by specifying details such as course duration, discipline, and number of sessions. The fourth section articulates the essential properties of concepts and their interrelations, clearly distinguishing core from non-core concepts based on pedagogical objectives. The fifth section establishes reference answers for each open-ended item, incorporating all elements developed in prior sections.

The article further outlines the rules for response correction. For question one, a response is correct only if the student adequately describes the concept in their own words, with verbatim replication of teaching materials deemed unacceptable. For question two, the response must provide a concrete example of the concept without conceptual errors. For question three, the student must present an integrative diagram representing core concepts and their relationships; conceptual inaccuracies or incoherencies invalidate the response. For question four, the student must describe how their understanding deepened after consulting additional sources, demonstrating conceptual development and clear articulation of ideas. For question five, the student must identify at least one conceptual misconception related to the content, whether personal or hypothetical; failures in recognizing or explaining the misconception render the response incorrect. For question six, the student must design a challenging exercise whose solution expands knowledge beyond classroom content; flaws in design, solution, or justification invalidate the response. Across all questions except the third, explicit mention of employed concepts is required, though evaluators may accept responses in which the concept is implicitly identifiable. In any question, non-original work, through copying or reproducing classroom examples, invalidates the response.

The article then details the full application of the guide to the content "We don’t have direct access to reality." This content constitutes the initial unit of a university course in Quantitative Methods in Psychology, structured across 15 four-hour sessions, with the first unit spanning four sessions. Its core conceptual framework asserts that quantitative methods do not directly represent reality but rather constitute treatments of reality.

The reference answers developed for each open-ended item demonstrate how the guide operationalizes the evaluation process, ensuring objectivity in scoring and logical coherence among core concepts. The article concludes by highlighting that the Approach-in-Process Test Version 2 provides a performance-based measure of learning approaches, requiring clear criteria for open-response assessment, now systematized through this guide.

- **Study 5: Correction Guide Template for the Approach-in-Process Test Version 2 and Its Contribution to Teacher Development**

ARAUJO, J.; GOMES, C. M. A. Template do guia de correção do Teste Abordagem-em-Processo versão 2. **Contribuciones a las Ciencias Sociales**, v. 16, n. 7, p. 5830-5847, 2023b. Available at: https://doi.org/10.55905/revconv.16n.7-093.

The article establishes that the validity of the Approach-in-Process Test Version 2 hinges entirely on the rigorous implementation of its Scoring Guide, as student responses can only be meaningfully evaluated against a predefined conceptual framework. Although primarily an assessment tool, the authors argue that the guide inherently functions as a catalyst for teacher development. This dual purpose arises because educators must systematically map the taught concepts before administering the test, compelling deliberate reflection on content organization, significance, and interrelationships. Consequently, the guide fosters evidence-based instructional planning grounded in metacognitive awareness.

The study details each component of the guide. The first component, Content Definition, delineates the conceptual domain for test application. The second, Core Concept Selection, distinguishes central from peripheral elements to assess structural understanding. The third, Contextualization, records teaching parameters, such as discipline and course duration, for nuanced interpretation. The fourth, Fundamental Properties, systematizes the conceptual framework for response scoring. Finally, the fifth component, Reference Answers, requires the teacher to produce model responses that articulate deep-learning behaviors within the teaching content. These reference answers function as benchmarks for scoring the six open-response items, exemplifying such behaviors as rephrasing core concepts in one's own words, generating concrete examples, constructing conceptual diagrams, pursuing deeper understanding, identifying misconceptions, and designing challenging exercises.

Effective application requires instructors to articulate how abstract concepts are manifested in observable ways in student work. The authors emphasize that implementation of the guide should ideally occur under technical supervision (e.g., from the Laboratory for Cognitive Architecture Mapping) to ensure fidelity to epistemological principles.

- **Study 6: Completing the Correction Guide as a Tool for Dialogic Pedagogical Reflection between the Teacher and the Guide's Specialist Tutor**

GOMES, C. M. A. A medida das abordagens de aprendizagem e seu impacto na prática pedagógica. In: **XXX Semana do Instituto de Matemática e Estatística (IME) e VII Seminário de Pesquisa e Pós-Graduação do IME/UFG**, 2023. Available at: https://doi.org/10.13140/RG.2.2.25544.90881/1.

The presentation opens with the theory of students' approaches to learning, first formulated by Marton and Säljö in the 1970s through studies on deep and surface processing in reading tasks. The concept was later generalized to other academic tasks

and defined as the conjunction of cognitive strategies and motivation that guide students' actions. This conjunction can support learning, as in a deep approach aligned with intrinsic motivation and complex cognitive operations, or hinder it, as in a surface approach aligned with extrinsic motivation and lower-level strategies.

Next comes the problem of measuring these approaches. Researchers have relied on self-report tests. These instruments present items that describe behaviors aligned with each approach, and respondents rate how often such behaviors occur. The core argument is that, although self-reports yield useful evidence, their vulnerability to biases such as social desirability and acquiescence undermines validity by adding noise to the data. This noise makes it harder to detect clear relations between approaches and academic performance.

To address this limitation, the presentation introduces LAICO's proposal for a new generation of performance-based instruments. This work is part of a research agenda launched in 2018, which assumes direct measures of learning behavior outperform self-reports.

One product of this agenda is the Approach-in-Process Test Version 2, designed to assess deep and surface approaches based on student responses to specific academic tasks. The test includes six open-ended items that require actions representative of a deep approach. The act of performing the task, rather than describing it, provides the evidence for the approach performed. Preliminary data show a correlation of 0.50 between scores on this test and academic performance, exceeding meta-analytic estimates for self-reports ($r \approx 0.26$). This gap suggests stronger validity for performance-based measures, while acknowledging the limits of the available sample.

To support pedagogical use, the project created a Scoring Guide that structures the evaluation of open responses. The Guide has five sections: content definition, selection of core concepts, contextualization, identification of conceptual properties, and construction of reference answers. The claim is that this procedure requires teachers to make explicit the conceptual network that structures the content they teach, which can turn the test into a tool for teacher development.

The presentation closes with reported impacts on teaching practice among teachers who used the test and the Guide. They stated that the tool prompted meaningful reflection on their own practice. A central point was the recognition that schools expect teachers to act directly on student learning, yet this action often stalls due to a lack of effective methods. The Test and the Scoring Guide offered a concrete path forward because the six behaviors assessed were seen as feasible in everyday classroom practice. The final claim is that the test not only yields a valid measure of learning approaches but also drives changes in practice by requiring teachers to make explicit the conceptual relations that structure content, which supports more integrated student learning.

This shift in practice becomes more visible as teachers complete the Guide. In the first section, when defining the content, many teachers report fundamental doubts. They ask what content they are actually teaching, whether it matches what they think they are

teaching, and whether assessing the full content is feasible. These questions trigger a reassessment of scope and organization. Content definition then becomes a formative moment that calls for strategic decisions and critical awareness about instructional intent. In the second section, selecting and naming the core concepts reinforces this formative role. In many subjects, this task is difficult because clear conceptual boundaries are not established. Teachers must reexamine their approach and distinguish conceptual content from its constituent units. A reported case from Biology illustrates this process. A teacher, when discussing parts of living beings, concluded that these parts are fundamental concepts in the field.

In the third section, the analysis of contextual aspects such as the subject, allotted time, and school and student characteristics helps teachers reflect on how these variables influence instruction and engagement. Perceived relevance of the subject, alignment between content and students' reality, and adequacy of time become central. Teaching is no longer treated as detached from context but is instead planned through a critical reading of educational conditions.

The fourth section, which requires specifying the properties of the concepts, is among the most challenging. Teachers must organize the concepts into a structure that makes their relations explicit. Many struggle with this task and begin to question how they have organized their course content. If teachers find it difficult to build a coherent conceptual scheme, students are unlikely to do so without support. This insight highlights the need to prioritize essential concepts, establish explicit relations among them, and present these relations to students in a systematic way. Many teachers recognize that they have been teaching fragmented content and begin to value the Guide as a tool for building more integrated and comprehensible instruction.

Taken together, these sections extend the central argument of the presentation. The Approach-in-Process Test Version 2 is not only a more valid measure but also a device that reshapes teaching practice by introducing conceptual and reflective demands that strengthen pedagogical intent. Completing the Guide mediates between student assessment and teacher development and reorganizes instruction around structured concepts and meaningful relations with the potential to improve learning quality.

- **Study 7: Applying the Correction Guide to a Biology Topic with the Teacher's Reflections on the Completion Process**

RODRIGUES, M. N. S.; GOMES, C. M. A. Aplicação do guia de correção do Teste de Abordagem-em-Processo Versão 2 como reflexão da prática pedagógica. **European Journal of Alternative Education Studies**, v. 8, n. 1, 2023. Available at: https://doi.org/10.46827/ejae.v8i1.4598.

The article examines the use of the Approach-in-Process Test Version 2 Scoring Guide not only as a tool to support the scoring of open-ended items but also as a means to promote detailed teacher reflection on the conceptual structure and organization of instruction. The analysis centers on a case in which a Biology instructor at the State

University of Minas Gerais completed the Scoring Guide for the topic Lissamphibia in the course Zoology of Chordates I. The teacher worked in dialogue with a specialist tutor for the Guide during completion.

At the outset, the teacher defined the instructional content as "Lissamphibia: General characteristics, diversity, and classification." The Guide then required identification of the core concepts to be taught. This step led the teacher to reflect on how textbooks in Zoology usually organize content by themes such as habitat, reproduction, circulatory system, and respiratory system, without treating these themes as concepts in the sense of interrelated conceptual units. The reflection showed a difference between organizing topics by theme and structuring them conceptually, and the Guide requires the latter.

During completion, the teacher initially listed "Class Lissamphibia" and "monophyly of amphibians" as distinct concepts. Through dialogic reflection with the specialist tutor, she recognized that these terms denote the same conceptual unit because monophyly defines Lissamphibia based on its synapomorphies. This realization of conceptual identity illustrates the formative nature of the process.

When describing fundamental properties, the teacher noted that some properties she had included under monophyly should stand as their own core concepts because they carry independent explanatory value. She reorganized respiratory properties under the core concept "Respiratory patterns in amphibians: Branchial, cutaneous, buccopharyngeal, and pulmonary." She explained that respiratory diversity reflects the adaptive need to alternate between aquatic and terrestrial environments. Cutaneous and buccopharyngeal respiration complement pulmonary respiration to ensure adequate oxygenation, given the constraints of a three-chambered heart and incomplete circulation.

She applied the same analysis to the circulatory system, reframing it as the core concept "Closed, double, incomplete circulatory system with a three-chambered heart," with detailed properties and functional implications. Similar reasoning supported establishing a core concept for the anuran reproductive cycle, since some amphibians show internal fertilization and paedomorphosis. The anuran cycle thus warranted treatment as a distinct conceptual unit within instruction on Lissamphibia.

At the taxonomic level, the teacher also organized the Orders Anura, Urodela, and Gymnophiona as core concepts and described for each the key morphophysiological properties that justify their taxonomic distinction.

Beyond the conceptual analysis, the Guide asks the teacher to draft reference answers for the open-ended items of the Approach-in-Process Test Version 2. The teacher grounded these answers in the structured concepts. For the conceptual description item, she used a hydraulic analogy to explain incomplete circulation in amphibians. For the concrete example item, she drew on the butterfly metamorphosis. For the schema construction item, she placed the monophyly of amphibians at the center and related it to respiratory patterns, the reproductive cycle, the circulatory system, and the

subdivisions Anura, Urodela, and Gymnophiona. For the deepening item, she simulated a student response that searched the literature for salamander species with internal fertilization and presented learning that extended beyond the class content. For the conceptual error identification item, she simulated a student who described how prior conceptions about amphibian groups had been mistaken before instruction. For the challenging exercise item, she simulated a student who created a multiple-choice question with justifications for conceptual errors and argued that such a task fosters active reflection.

The article concludes that guided use of the Scoring Guide with technical and reflective support from a specialist does more than standardize evaluation. It also promotes critical analysis of teaching practice. The reflection led the teacher to reorganize content conceptually and to shift from a thematic presentation to instruction anchored in fundamental concepts and their structural properties. In this way, the formative process moves beyond assessment and contributes directly to improved instructional quality.

- **Study 8: Applying the Correction Guide to a Developmental Psychology Topic with the Teacher's Commentary**

ARAUJO, J.; DANIEL, M. Q. S.; GOMES, C. M. A. Guia de Correção do Teste Abordagem-em-Processo (Versão 2) e sua aplicação no conteúdo "Questões epistemológicas na aquisição dos conhecimentos na teoria de Jean Piaget". **European Journal of Education Studies**, v. 10, n. 4, 2023. Available at: https://doi.org/10.46827/ejes.v10i4.4741.

The article reports the use of the Scoring Guide with the topic "Epistemological issues in knowledge acquisition in Jean Piaget's theory" in the course Psychogenesis of Knowledge, part of an undergraduate teacher education program at a public university. The instructor selected this topic for its formative value for future teachers. It addresses fundamental concepts, such as the active subject, which are essential for understanding teaching and learning.

The topic focuses on the role of the subject in constructing knowledge, which is central in Piaget's theory. The instructor identifies a single core concept: All knowledge is constructed through the interaction between subject and object. The content includes several notions, yet after reflection the instructor judged them to be subordinate to this central idea. They function as specific properties that unfold and detail the unifying concept. This concept rejects two opposed positions. It rejects radical empiricism, which assumes a blank slate and also rejects strict nativism. The subject begins development with innate schemes. Knowledge develops through successive interactions between the subject and the environment. These interactions are structured by assimilation, accommodation, and adaptation. Assimilation occurs when the subject understands the object only through prior schemes with no change in those schemes. Accommodation occurs when the subject's schemes change in light of the object's properties. Adaptation results from the interplay between assimilation and accommodation.

The instructor uses the course's placement at the end of the program to revisit and deepen prior ideas. She notes that students often retain distorted views of Piaget's theory. The article presents reference responses that the instructor wrote for each of the six open-ended items. A hypothetical student is assumed to have produced these answers. In the first item, the student defines the blank slate and explains that the subject absorbs knowledge directly from the environment without the action of internal schemes. In the second item, the student provides a concrete example of assimilation and accommodation and contrasts it with a teacher's mistaken belief that attention alone leads students to absorb content. The third item presents a visual schema that summarizes the relations among subject, object, assimilation, accommodation, and adaptation, and highlights the balance between innate and environmental factors. In the fourth item, the student describes further learning based on a book and explains a shift from viewing the blank slate only within knowledge construction to seeing it as an idea that guided science more broadly. In the fifth item, the student corrects a misunderstanding about assimilation and clarifies that changes in schemes result from accommodation, not assimilation. In the sixth item, the student proposes a challenging assessment that requires the identification and justification of conceptual errors concerning the active subject.

The authors conclude that the Approach-in-Process Test Version 2, used with its Guide, serves two functions. It helps instructors evaluate students' learning approaches with more precision by focusing on actual learning behavior. It also prompts instructors to review their own practice as they complete the Guide and to make explicit the concepts and structures that support instruction. The process supports student development and improves teaching quality. The application described took place under the technical supervision of a LAICO specialist.

- **Study 9: Applying the Correction Guide to a Physics Topic and Pedagogical Reflection**

CARVALHO, J. P.; GOMES, C. M. A. Aplicação do Guia de Correção do Teste Abordagem-em-Processo (Versão 2) no conteúdo "Corrente elétrica". **European Journal of Education Studies**, v. 10, n. 4, 2023. Available at: https://doi.org/10.46827/ejes.v10i4.4753.

The article reports the use of the Scoring Guide for the topic of electric current in a Physics course taught by a third-year upper secondary education teacher in a private school. The teacher selected this topic because it underpins many other areas of Physics. The central concept is electric current. The teacher mapped a network of complementary concepts necessary to understand the central concept. These concepts include electric charge, electrical conductor, electric force, electric field, and potential difference. Each concept is described in detail. The teacher then presents reference responses for each of the six open-ended items of the Test.

In the conclusion, the teacher explains that completing the section on fundamental properties required a thorough review of the concepts and their relations, which led her to reorganize lessons and teaching materials. She also describes challenges in drafting the reference responses and acknowledges that her prior practice elicited few behaviors associated with a deep approach. As a result, she incorporated activities that explicitly promote such behaviors, revised her instructional strategies, and proposed tasks better aligned with the development of a deep approach.

- **Study 10: Applying the Correction Guide to a Brazilian Upper Secondary Curriculum Topic: Fostering the Active Learner**

SANTOS, A. M.; ARAUJO, J.; GOMES, C. M. A. Aplicação do Guia de Correção do Teste Abordagem-em-Processo Versão 2 no conteúdo "A adolescência como construção social". **European Journal of Education Studies**, v. 10, n. 5, 2023. Available at: https://doi.org/10.46827/ejes.v10i5.4774.

The article argues that the Approach-in-Process Test Version 2 and its Scoring Guide align with Brazil's New Upper Secondary Curriculum. Both seek to expand student agency, promote deeper learning, and cultivate an active, critical, and reflective learner. The article highlights the value of the Test and the Guide as methodological tools for this curriculum.

It reports the use of the Scoring Guide for the topic "Adolescence as a social construction" in the course Life Project within the New Upper Secondary model. The central concept states that adolescence is purely a social construction. The topic belongs to the first module of the course and was taught in a state public school in an urban area with social vulnerability. The teacher formulates the fundamental properties in a logical sequence. First, adolescence is purely a social construction that arises in modernity and is not a natural phenomenon of the individual. Second, every social construction depends on its sociohistorical context and varies by time and place. The logical conclusion is that adolescence is a strictly sociohistorical and cultural product of a given context. From this perspective, adolescence emerged during the Industrial Revolution due to the period of latency that kept youth out of the labor market for longer and in school for longer.

In the fifth section of the Scoring Guide, the teacher wrote reference answers for each of the six open-ended items of the Approach-in-Process Test Version 2.

In the first item, the reference answer simulates a student who defines the concept in their own words with accuracy and authenticity. For example, the sentence "This means that typical adolescent behaviors cannot be explained by natural laws" does not repeat the class definition. It demonstrates understanding and expressive autonomy.

In the second item, the answer provides a concrete example by contrasting the experiences of today's adolescents with those of past generations. It grounds the example in observable practices such as internet use, fast-food consumption, and the freedom to go out alone.

In the third item, the concepts are presented in a coherent way that explains how adolescence emerges as a social construction. The answer articulates two central properties, extended schooling and delayed entry into work, and shows how they produce social latency, which defines adolescence.

In the fourth item, the reference answer presents an external source that the hypothetical student consulted. The student contrasts this source with classroom learning and shows further understanding based on that contrast.

In the fifth item, the hypothetical student acknowledges a conflict between a personal belief that natural factors also shape adolescence and the class definition, which presents adolescence as purely a social construction. The student demonstrates metacognitive care to prevent personal belief from distorting correct understanding under the adopted approach.

In the sixth item, the answer simulates the design of an exercise with statements that require conceptual judgment. The challenge is to decide, based on the concept that adolescence is purely a social construction, which statements are correct and to justify the incorrect ones. The task goes beyond recall and requires the student to apply conceptual understanding in analysis and judgment.

In conclusion, the article argues that completing the Scoring Guide not only prepares teachers to administer the test effectively but also serves as a reflective tool for practice. The Guide helps teachers align instruction with behaviors expected in deep approaches and identify specific difficulties in how students process content. This information can support more precise pedagogical interventions. The described application took place under the technical supervision of a LAICO specialist.

- **Study 11: Applying the Correction Guide to a Management Topic for Brazil's New Upper Secondary Curriculum**

SALLUM, M. T.; GOMES, C. M. A.; ASSIS, I. S. D. Aplicação do Guia de Correção do Teste Abordagem-em-Processo Versão 2 no conteúdo "Canvas Modelo de Negócios Adaptado para Gerar Boas Atividades pelos Adolescentes". **European Journal of Education Studies**, v. 12, n. 4, 2025. Available at: https://doi.org/10.46827/ejes.v12i4.6008.

The article presents the use of the Scoring Guide with a specific topic: a Business Model Canvas adapted to help upper secondary students design activities for personal growth and social impact. The Canvas, originally created for strategic business planning, was reframed to shift the focus from profit to formative value and social relevance. This adaptation required reorganizing the topic around concepts relevant to education.

The central argument is that the Guide's conceptual organization enables more precise and logical instruction. It prevents the mere repetition of isolated definitions and supports explicit treatment of essential properties and relations. The central concept is that business models can be adapted to help students design effective activities. Four derived concepts follow from this core: Value Proposition, Customer Segmentation, Customer Relationships, and Key Partnerships.

The authors show how each concept unfolds into fundamental properties. Value Proposition serves as the starting point for planning. It requires aligning the value perceived by the student with the value perceived by the activity's audience. It also calls for identifying non-obvious aspects that enhance relevance. Customer Segmentation requires identifying target groups with specific needs and values. It asks students to understand different audiences and adjust the activity to fit them. Customer Relationships involves the planned maintenance of ties with these audiences through communication strategies before, during, and after the activities. Key Partnerships recognizes that projects often depend on external support and highlights the need to identify and mobilize collaborators.

The article also presents model answers written during completion of the Guide. These answers illustrate how students can express understanding of the concepts and their relations.

- **Question 1:** Put it in your own words. The reference answer models the behavior of explaining a concept in one's own words without copying definitions. The hypothetical student shows command of the concept Value Proposition by using a meaningful analogy: "I take the role of an archaeologist who removes surface layers to reveal hidden artifacts." This image conveys that the value of an activity goes beyond what is visible and includes subjective and social elements that must be discovered. The sentence "These discoveries transform a simple idea into a proposal with broad and lasting meaning" shows conceptual clarity and authorship.
- **Question 2:** Give a concrete example. The reference answer offers a concrete example within a daily conversation between peers. The hypothetical student reports a discussion with a friend who saw no use in planning for the future. He then shows how the lesson, first framed as "planning the future," also teaches "task prioritization," which has immediate use. The answer shows understanding of a property of Value Proposition, the identification of non-obvious features of an activity. The friend's shift as she sees the value of prioritization in the present confirms the application of the concept to a real situation.
- **Question 3:** Organize the concepts in a schema. The hypothetical student presents a schema with five concepts. The central concept appears at the top, and four subordinate concepts follow. The schema is logical. It starts from the core idea that business models can be adapted and unfolds into Value Proposition, Customer Segmentation, Customer Relationships, and Key Partnerships as ways to implement the core idea. Each subordinate concept is correctly positioned as a means to implement the central concept. The descriptions are brief and clear. For Value Proposition, the schema states "It is the starting point." The schema displays command of the topic and logical articulation among concepts.
- **Question 4:** Show deeper understanding. The reference answer shows that the hypothetical student selected Customer Segmentation and went beyond the class

content. He consulted a specific section of Business Model Generation and integrated it with what he learned in class. He notes that mass markets do not always display audience differentiation. This insight deepens the idea that segmentation presupposes a diversity of profiles. The comparison between the class lesson and the book shows autonomous conceptual progress and the ability to integrate sources.

- **Question 5:** Correct a possible misconception. The hypothetical student reports that he first saw customer relationships as a single interaction limited to the moment of the activity. After the lessons, he came to understand customer relationships as continuous strategies before, during, and after the activity. By stating the change and the new planned approach, the answer shows critical review and correction of a relevant misconception.
- **Question 6:** Design a challenging exercise. The exercise consists of statements that the student must judge as correct or incorrect, with justification. The options mix true statements with a subtle false statement. This raises cognitive demand. For example, the statement "First define the Value Proposition, then Customer Segmentation" is incorrect. Only a student who understands their interdependence will detect the error and explain it. The expected justification is that Value Proposition and Customer Segmentation are developed in parallel, not in sequence. The exercise promotes the articulation of concepts and logical reasoning and aligns with a deep approach to learning.

In conclusion, the authors argue that completing the Scoring Guide supports scoring of the Approach-in-Process Test Version 2 and also serves teacher development. It requires critical analysis and refinement of the conceptual architecture of the topic. This process increases the internal coherence of teaching materials and their pedagogical potential. It aligns with active methodologies and with Brazil's New Upper Secondary model, which seeks to foster student agency in learning.

- **Study 12: Developing Instructional Materials Based on the Approach-in-Process Test Version 2 and Correction Guide for an Experimental Study**

SALLUM, M. T.; GOMES, C. M. A. A construção de aulas ativas no conteúdo "Canvas Modelo de Negócios adaptado para gerar boas atividades pelos adolescentes". 2024. **Apresentação no Third Annual LAICO Meeting**, Universidade Federal de Minas Gerais, Belo Horizonte, 2024. Available at: https://www.researchgate.net/publication/385626790.

The presentation outlines a pedagogical intervention conducted within an experimental study to test whether an active teaching methodology improves student learning. The central claim is direct. An active methodology grounded in the Approach-in-Process Test Version 2 and its Correction Guide can increase students' deep approach and promote greater knowledge acquisition than a traditional methodology.

To test this claim, the authors built an experiment with two groups. The experimental group received the active methodology. The control group received the

same content taught with traditional lessons. The conceptual content was held constant across groups so that the only manipulated variable was the teaching methodology.

The proposal rests on the theory of learning approaches. Students can adopt surface or deep approaches to school content. Surface approaches often appear as rote memorization, vague understanding, and low engagement. Deep approaches involve meaning making, links to prior knowledge, curiosity, and higher involvement in learning. The presentation argues that an active methodology designed with the Approach-in-Process Test Version 2 and the Scoring Guide can foster deep-approach behaviors.

Both groups received the same sequence of four 50-minute lessons. Both studied the same conceptual content. The topics were the central concept, Value Proposition, Customer Segmentation, Customer Relationships, and Key Partnerships. Both groups used a version of the Business Model Canvas adapted to the school context.

The groups differed in their teaching methodology. The experimental group followed an active methodology explicitly aligned with the behaviors assessed by the Approach-in-Process Test Version 2 and with concept-focused instruction guided by the Scoring Guide. The lessons promoted student authorship, concrete examples, schema construction, review of one's own errors, conceptual deepening, and the design of challenging exercises. Students worked collaboratively with templates, concept map analysis, and continuous teacher guidance.

The control group received traditional instruction. They also completed practical activities. These activities were not designed around the target behaviors defined by the Test. The instruction did not include the same strategies to promote a deep approach or the practices of self-assessment and review employed in the active methodology.

In sum, the presentation sets out a clear rationale. An active methodology based on the Approach-in-Process Test Version 2 and its Scoring Guide can support deeper and more meaningful learning. To evaluate this, the authors created two sets of instructional materials grounded in distinct methodologies but matched for content and time. By holding these elements constant and varying only the methodology, the experimental design secures the control needed to estimate the pedagogical effects of different approaches. The presentation does not report the intervention itself. It documents the materials that will make the study possible and ensures transparency and rigor in the study's preparation.

- **Study 13: Designing Pedagogical Activities Based on the Approach-in-Process Test Version 2 and Correction Guide**

ALMEIDA, A. M. S.; GOMES, C. M. A.; RODRIGUES, M. N. S.; ARAUJO, J. O Teste Abordagem-em-Processo Versão 2 como recurso pedagógico no Novo Ensino Médio. **Cuadernos de Educación y Desarrollo**, v. 16, n. 6, 2024. Available at: https://doi.org/10.55905/cuadv16n6-053.

The article advances a pedagogical proposal that links the goals of Brazil's New Upper Secondary model, the principles of active learning, and the theory of learning approaches. The core claim is clear. The new curriculum seeks more effective learning through student agency and autonomy. This aim calls for practices that draw students into active knowledge construction. Active learning follows the same principle by centering instruction on the student, authorship, critical thinking, and the ability to assign meaning to the content learned. The theory of learning approaches strengthens this direction by showing that surface or deep engagement with content directly affects quality learning.

Within this context, the authors argue that the Approach-in-Process Test Version 2 and its Scoring Guide function as pedagogical tools that support active methodologies. When teachers complete the Guide, they conduct a conceptual and contextual analysis of the target content. This work leads to the design of activities that foster a deep approach. The Test also organizes target behaviors that can anchor the creation of such activities. The combined use of the Test and the Guide therefore goes beyond assessment and becomes a starting point for building instructional interventions that promote more meaningful learning.

The article illustrates this process by describing three activities for the topic "Adolescence as a social construction" in the Life Project course of the New Upper Secondary model. A teacher designed these activities while completing the Scoring Guide. Each activity aligns with a behavior assessed by the Test.

The first activity develops the behavior of describing a concept in one's own words with as much detail as needed. The goal is to help students' express concepts with authorship rather than merely reproduce them. This requires identifying the concept's fundamental properties and stating them with clarity and accuracy while preserving the intended meaning. Students work in groups to analyze and rewrite the concept and may use varied expressive forms such as drawings, analogies, and poems, as long as they preserve conceptual content.

The second activity develops the behavior of producing a concrete example that demonstrates an understanding of a concept. The task asks students to relate the concept to real situations and assess the adequacy of given examples. The activity uses six examples and requires students to judge whether each one represents the concept of adolescence as a social construction and justify their judgments based on the relevant properties. The task deepens conceptual understanding by promoting critical analysis and practical application.

The third activity develops the behavior of creating a schema that clearly shows how the fundamental elements of the content are related. The focus is on relations among the concepts that compose the topic. Students interpret a proposed schema and write a text that makes explicit the conceptual connections it represents. The activity addresses fragmented understanding and encourages a relational and integrated view of the content.

The article's line of reasoning is consistent. Using the Approach-in-Process Test Version 2 and the Scoring Guide prompts teachers to reflect on content, student context, and instructional goals. This reflection leads to activities that foster a deep approach and makes the Test into a planning tool. The practices described show that the Test and the Guide cease to be only assessment instruments and become part of the design of more effective instruction that is conceptually structured and student-centered. The approach aligns with the goals of the New Upper Secondary model and the principles of active learning.

2. Discussion

The 13 studies presented demonstrate that the Approach-in-Process Test Version 2 and its Scoring Guide constitute a methodological and pedagogical innovation with multiple dimensions of impact. As a performance-based instrument, TAEPv2 addresses a fundamental limitation in the assessment of students' approaches to learning: the reliance on self-report measures vulnerable to response biases and social desirability effects. The evidence across diverse academic contents and educational contexts shows that the Test yields stronger correlations with academic performance ($r \approx 0.50$) than meta-analytic estimates for self-report instruments ($r \approx 0.26$), suggesting enhanced construct validity through direct behavioral assessment.

Beyond measurement precision, the studies reveal a dual pedagogical function. The Scoring Guide, while designed to standardize the evaluation of open-ended responses, consistently emerged as a catalyst for teacher development. Completing the Guide requires educators to engage in systematic conceptual mapping, distinguishing core from peripheral concepts, articulating fundamental properties, and constructing reference answers that exemplify deep-approach behaviors. This process prompts critical reflection on content organization, instructional coherence, and pedagogical intent. Teachers across multiple studies reported that the Guide led them to reorganize fragmented content, establish explicit conceptual relations, and design activities that directly foster deep-approach behaviors. The consequential validity of the Test and Guide is thus demonstrated not only through improved student self-assessment but also through documented shifts in teaching practice toward more conceptually structured and student-centered instruction.

The development of TAEPv2 and its Scoring Guide was enabled by LAICO's particular trajectory and the convergence of three interrelated research agendas. First, the laboratory's sustained investment in psychometric innovation provided the technical foundation for performance-based assessment. The development of scoring rubrics for open-ended responses, the application of psychometric techniques to validate performance-based instruments, and the use of machine learning algorithms created the methodological infrastructure necessary for instruments that assess complex constructs through authentic student performance. Second, LAICO's research agenda on

performance-based assessments, initiated in the 2010s with metacognition and later extended to students' approaches to learning, established both the theoretical rationale and the empirical experience required to design instruments that move beyond self-report measures. Third, and perhaps most distinctively, LAICO's integration of psychometrics and educational psychology enabled the Test and Guide to function simultaneously as measurement tools and pedagogical interventions. This dual functionality reflects the laboratory's commitment to democratizing assessment tools while advancing psychoeducational construct research.

Few research contexts combine expertise in test validation, advanced psychometric methods, and sustained engagement with educational practice in ways that support the iterative development and refinement of performance-based instruments across multiple content domains and school contexts. The 13 studies presented here illustrate how this convergence materialized: technical supervision by LAICO specialists ensured scoring reliability and conceptual coherence, while collaborative dialogue between teachers and specialist tutors during Guide completion fostered pedagogical reflection and instructional improvement. The systematic research agenda from 2022 to 2025 thus exemplifies how LAICO's methodological trajectory created the conditions for instruments that assess learning approaches through authentic responses while simultaneously strengthening teaching practice.

The studies also demonstrate alignment with contemporary educational reforms and active learning principles. The Test and Guide support the goals of Brazil's New Upper Secondary Curriculum by fostering student agency, promoting deeper engagement with content, and enabling teachers to design interventions grounded in evidence of students' learning processes. The categorization of errors in superficial learning approaches (Study 3) and the design of pedagogical activities based on deep-approach behaviors (Study 13) illustrate how the instruments support process-centered pedagogy and adaptive assessment.

Important limitations remain. TAEPv2 has not yet undergone full psychometric validation, and ongoing studies are examining its internal structure and measurement properties. The experimental study currently underway will provide evidence on the causal impact of pedagogical interventions based on the Test on student learning outcomes. These initiatives will consolidate both the measurement properties and the consequential validity of the instrument. Additionally, broader implementation will require strategies to support teachers in completing the Scoring Guide without direct specialist supervision, potentially through structured training programs or digital scaffolding tools.

The research agenda presented here contributes to the theory of students' approaches to learning by demonstrating the feasibility and validity of performance-based assessment in this domain. It also advances methodological discussions on the design of instruments that integrate assessment and pedagogical intervention. Future research should examine the Test's applicability across additional content domains,

educational levels, and cultural contexts, as well as investigate the mechanisms through which completing the Scoring Guide influences teaching practice and student learning.

3. Conclusion

The development, application, and analysis of the Approach-in-Process Test Version 2 (TAEPv2) and its Scoring Guide reveal a coherent set of conceptual, methodological, and pedagogical contributions. These instruments were designed not only to assess students' approaches to learning but also to reconfigure teaching practice by embedding conceptual and reflective demands into instructional planning, mediation, and assessment. Across the studies presented, the Test and the Guide have provided evidence of consequential validity, since their use promotes student self-assessment, supports teacher development, strengthens pedagogical planning, and fosters the design of interventions grounded in active methodologies. This systematic research agenda (2022-2025) exemplifies how the convergence of psychometric expertise, methodological innovation, and commitment to performance-based assessment can generate instruments that simultaneously advance construct measurement and pedagogical practice.

Their integration with the principles of Brazil's New Upper Secondary Curriculum, the students' approaches to learning theory, and active methodologies highlights their potential to foster deeper and more meaningful learning. Their application across varied content areas, school contexts, and educational levels illustrates versatility and emphasizes the importance of technically guided use that preserves conceptual coherence and pedagogical intent.

At present, TAEPv2 has not yet undergone full psychometric validation. We are conducting studies to consolidate empirical evidence on its internal structure and measurement properties. In parallel, we are carrying out an experimental study to examine the impact of pedagogical interventions based on the Test on student learning. These ongoing initiatives will provide the empirical foundation needed to consolidate both the measurement properties and the consequential validity of the instrument. Future research should also examine strategies to support broader implementation, including structured training programs for teachers and the potential for digital scaffolding tools that preserve the conceptual coherence and pedagogical intent of the Scoring Guide.

Conflict of Interest Statement
The authors declare no conflicts of interest.

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