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INSTRUCTIONAL DESIGN FOR DEEP APPROACH TO LEARNING: PEDAGOGICAL INTERVENTION IN LEARNING PROCESSES THROUGH THE APPROACH-IN-PROCESS TEST VERSION 2 AND ITS SCORING GUIDE

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Abstract:
Active methodologies alone do not guarantee deep approach to learning. This article presents an instructional design framework that enables direct pedagogical intervention in learning processes through the Approach-in-Process Test Version 2 (TAEPv2) and its Scoring Guide. Unlike conventional approaches that focus on student activity, our framework emphasizes intentional lesson construction targeting six deep approach behaviors: (1) describing concepts with own words and detail, (2) creating concrete examples, (3) constructing relational schemas, (4) deepening understanding of taught content, (5) detecting possible misunderstandings, and (6) designing challenging exercises. We demonstrate this framework through a lesson sequence on "Adapted Business Model Canvas for Generating Quality Activities by Adolescents," showing how the Scoring Guide transforms pedagogical practice by requiring teachers to: (a) explicitly delimit fundamental properties of key concepts, (b) establish essential conceptual relationships, (c) design activities that directly promote deep approach behaviors, and (d) intervene systematically in students' learning processes. The framework represents a paradigm shift from activity-centered to process-centered instruction, offering educators a rigorous methodology for transforming pedagogical intentions into concrete interventions that foster conceptual understanding and deep approach to learning.

Keywords: instructional design, pedagogical intervention, learning approaches, active methodologies, teaching-learning process, conceptual understanding

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1. Introduction

The proliferation of active methodologies in educational contexts has been accompanied by an implicit assumption: that student activity inherently generates a deep approach to learning. However, this assumption lacks empirical support. The Learning Approaches Theory, founded by Marton and Säljö (1976a, 1976b) and developed by Biggs (1978, 1985) demonstrates that learning culminates in two fundamentally antagonistic forms: the deep approach, characterized by high-level cognitive processes such as meaning construction and genuine desire for improvement, and the surface approach, marked by mechanical learning and weak commitment (Gomes, 2011a, 2013; Almeida et al., 2024).

Active methodologies are understood as pedagogical practices that position students as protagonists in knowledge construction, contrasting with traditional transmission-based instruction (Bacich & Moran, 2018; Avraam et al., 2025). In these methodologies, the teacher's role transforms from authority figure and exclusive source of knowledge to facilitator and mediator of learning processes (Lovato et al., 2018). However, this transformation in the teacher's role does not automatically translate into a transformation in student learning approaches.

This gap between pedagogical intentions and concrete outcomes demands systematic methodologies that enable teachers to design instruction targeting specific deep approach behaviors rather than merely hoping these behaviors emerge spontaneously from student activity. The Approach-in-Process Test Version 2 (TAEPv2) and its Scoring Guide, developed through a comprehensive research program, address this challenge by providing educators with tools for transforming pedagogical practice and directly intervening in learning processes.

2. TAEPv2 and its Scoring Guide as Pedagogical Transformation Tools: Evidence from LAICO's Research Program

The Laboratory for the Investigation of Cognitive Architecture (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, applied psychometric techniques in innovative ways, 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.

Figure 1: Research Areas of LAICO

The Problem of Individual Measurement
(André et al., 2023a, 2023b; Ferreira & Gomes, 2017; Gomes, 2021a; Gomes, Araujo et al., 2018; Gomes & Golino, 2015b; Gomes et al., 2022b, 2023, 2024; Gomes et al., 2014; Jelihovschi et al., 2025; Jelihovschi & Gomes, 2019).

Applications of Machine Learning
(Casanova et al., 2023; Golino & Gomes 2014a, 2014c, 2016; Golino et al., 2014; Gomes & Almeida, 2017; Gomes, Amantes, et al., 2020; Gomes, Farias, et al., 2021; Gomes & Jelihovschi, 2019; Gomes, Lemos, et al., 2020, 2021; Gomes, Fleith, et al., 2020; Gomes & Valentini, 2019; Gomes et al., 2013; Pazeto et al., 2019, 2020; Monteiro et al., 2020; Teodoro et al., 2021).

Intelligence
(Alves et al., 2012; Costa et al., 2024; Gomes, 2010a; Gomes & Borges, 2007, 2008c; Gomes & Golino, 2012a; Gomes, Golino, Santos, et al., 2014; Martins et al., 2018; Muniz et al., 2016).

Collaborations with Other Laboratories for Test Validation
(André et al., 2016, 2017, 2018, 2019, 2020a, 2020b, 2020c, 2020d, 2020e, 2021a, 2021b, 2021c, 2023a, 2023b, 2024; Araujo et al., 2018; Casanova et al., 2021; Costa et al., 2012; Fleith, Almeida, et al., 2020; Fleith et al., 2023; Fleith & Gomes, 2019; Fleith, Gomes, et al., 2020; Mansur-Alves et al., 2021; Matos et al., 2019; Mecca et al., 2015; Pedrosa et al., 2023, 2025; Reis et al., 2021; Rosa et al., 2013; Salami et al., 2021).

Students' Approaches to Learning
(Almeida et al., 2024; Araujo, Daniel, et al., 2023; Araujo & Gomes 2023a, 2023b; Carvalho & Gomes, 2023; Costa et al., 2024; Gomes 2010c, 2011a, 2020b, 2023; Gomes, Araujo, et al., 2022; Gomes, Farias, et al., 2022, 2024; Rodrigues & Gomes, 2020, 2023; Santos et al., 2023).

Cognitive and Educational Intervention
(Araujo & Gomes, 2023a; Cardoso et al., 2019; Gomes, 2002, 2007a, 2007b, 2020a, 2020c, 2021b; Gomes et al., 2008, 2014; Pereira et al., 2019; Ricci et al., 2020).

The Problem of Measurement and Psychometric Advances
(Araujo, Gomes, et al. 2023; Farias et al., 2024; Gauer et al., 2010; Golino & Gomes, 2015a, 2015b, 2015c, 2015d, 2015e, Golino et al. 2015, 2021; Gomes & Farias, 2022; Gomes & Gjikuria, 2017; Gomes & Jelihovschi, 2016; Gomes et al., 2013, 2017, 2019; Haase, et al., 2010; Monteiro et al., 2020; Reppold et al., 2015; Rosário et al., 2019; Valentini et al., 2015).

Metacognition
(Castillo-Diaz & Gomes, 2022; Castillo-Diaz et al., 2022; Costa et al., 2024; Dias et al., 2015; Diaz & Gomes, 2021b; Gomes, Golino, et al., 2014; Gomes & Jelihovschi, 2024; Laros et al., 2014; Pires & Gomes, 2018).

Educational Assessments
(Golino et al., 2021; Gomes, 2005, 2021c; Gomes & Borges, 2008b, 2009a; Gomes et al. 2016, 2018; Gomes, Golino, et al., 2020, 2021; Pires & Gomes, 2017, 2018).

Democratization of Testing
Students' Approaches to Learning Scale (Gomes, 2022c).
Approach-in-Process Test – Version 2 and Correction Guide (Gomes, 2022b; Gomes et al., 2022a).
Battery of Higher-Order Cognitive Factors – BAFACALO (Gomes & Araujo, 2025a, 2025b, 2025c, 2025d; Gomes & Nascimento, 2021a, 2021b, 2021c, 2021d, 2021e, 2021f, 2021g, 2021i, 2021j, 2021l, 2021m, 2021n, 2021o, 2021p; Gomes, Nascimento, et al., 2021a, 2021b, 2021c, 2021d).
Reflective Thinking Interest Scale (Gomes, 2022a).
Activity Flow and Habitual Flow (Gomes & Nascimento, 2024).

Figure 2: Examples of Tests Developed by LAICO

1) Learning Approaches Scale
[assesses learning approaches; self-report test] (Gomes, 2010c, 2011a, 2013; Gomes, Farias, et al., 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 et al., 2023; Carvalho & Gomes, 2023; Gomes, 2023; Gomes, Araujo, et al., 2022; Rodrigues & Gomes, 2023; Sallum et al., 2025; Santos et al., 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, et al., 2023; Gomes & Linhares, 2018; Gomes, Linhares, et al., 2021; Gomes & Nascimento, 2021h; 2021k, 2022; Gomes, Quadros, et al., 2020).

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 et al., 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, 2014b; Gomes, 2010a, 2010b, 2011b, 2012b; Gomes & Borges, 2009b, 2009c; Gomes, de Araujo, et al., 2014; Gomes, Golino, Santos, et al., 2014).

7) Metacognitive Monitoring Test – MMT
[assesses metacognition; performance-based test] (Castillo-Diaz & Gomes, 2022; Golino & Gomes, 2011; Gomes, Araujo et al., 2021; Gomes, Golino, et al., 2014).

8) School Aspirations Questionnaire
[assesses school aspirations; self-report test] (Gomes & Gjikuria, 2018).

9) Activity Flow
[assesses flow experienced by the individual during an activity; self-report test] (Gomes & Nascimento, 2024).

10) Habitual Flow
[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] (Castillo-Diaz & Gomes 2023; Castillo-Diaz et al., 2022; Diaz & Gomes, 2021a, 2021b).

12) Inductive Reasoning Test – Second Revision (IRT-SR)
[assesses intelligence through performance] (Gomes, Araujo, Lima, et al., 2021, 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 et al., 2009).

14) Procrastination Mechanisms Questionnaire
[assesses procrastination; self-report test] (Gomes & Rozenberg 2021, Gomes, Rozenberg, et al., 2023).

15) Thinking Styles Inventory
[assesses thinking styles; self-report test] (Gomes & Marques, 2016; Gomes, Marques, et al., 2014).

16) Self-Referent Academic Cognitions Scale
[assesses self-concept, self-efficacy, self-esteem, and value in academic contexts; self-report test] (Costa et al. 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 et al., 2022c).

The current article details studies on the Approach-in-Process Test version 2 (TAEPv2) and its Scoring Guide. 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.

LAICO conducted 13 studies demonstrating that TAEPv2 and its Scoring Guide function not merely as assessment instruments but as pedagogical transformation tools (Almeida et al., 2024, 2025; Araujo & Gomes, 2023a, 2023b; Araujo et al., 2023; Carvalho & Gomes, 2023; Gomes, 2023; Gomes, Araujo, et al., 2022; Gomes, Jelihovschi, et al., 2022; Rodrigues & Gomes, 2023; Sallum & Gomes, 2024; Sallum et al., 2025; Santos et al., 2023). These studies reveal three fundamental dimensions of this transformation: (1) promotion of teacher reflection on pedagogical practice, (2) enhancement of student self-assessment quality, and (3) systematic support for designing activities that directly intervene in learning processes (Gomes, 2023; Araujo & Gomes, 2023a, 2023b).

The first dimension, teacher reflection, emerges from the Scoring Guide completion process. Teachers must explicitly delimit: (a) fundamental properties of key concepts, (b) essential relationships among these concepts, (c) conceptual structure organizing content, and (d) reference answers exemplifying deep approach behaviors (Gomes, Araujo et al., 2022b; Araujo & Gomes, 2023b). This process demands profound conceptual analysis that frequently reveals gaps in content organization. Teachers's report recognizing that they had been teaching fragmented content without making conceptual relationships explicit (Rodrigues & Gomes, 2023; Carvalho & Gomes, 2023).

A paradigmatic case illustrates this transformation. A Biology teacher, when completing the Scoring Guide for Lissamphibia content, initially organized material thematically (habitat, reproduction, circulatory system, respiratory system) without treating these themes as interrelated conceptual units. Through dialogic reflection with a specialist tutor during Guide completion, she reorganized content around core concepts with explicit fundamental properties and essential relationships. For example, she established "Respiratory patterns in amphibians: Branchial, cutaneous, buccopharyngeal, and pulmonary" as a core concept, explaining that respiratory diversity reflects THE adaptive need to alternate between aquatic and terrestrial environments, with cutaneous and buccopharyngeal respiration complementing pulmonary respiration given constraints of a three-chambered heart and incomplete circulation (Rodrigues & Gomes, 2023).

Similar transformations occurred across diverse content areas: electric current in Physics (Carvalho & Gomes, 2023), epistemological issues in Piaget's theory in Developmental Psychology (Araujo, Daniel & Gomes, 2023), adolescence as social construction in Life Project course (Santos, Araujo & Gomes, 2023), and adapted Business Model Canvas (Sallum, Gomes & Assis, 2025). In all cases, teachers reported that Guide completion required fundamental rethinking of content organization, prioritizing essential concepts over information accumulation, and making conceptual relationships explicit rather than leaving them implicit.

The second dimension, student self-assessment enhancement, derives from TAEPv2's structure. The test provides: (a) objective parameters through structured items capturing deep approach behaviors, (b) external feedback centered on active learner, (c) self-evaluation anchored in product (instructional content), and (d) calibration of self-assessment through comparison between student performance expectations and teacher feedback (Araujo & Gomes, 2023a). This structure addresses a critical problem: leaving students unsupported during self-evaluation induces biases such as Dunning-Kruger effect and inaccurate judgments. TAEPv2 provides systematic support while maintaining focus on learning processes rather than merely final products.

The third dimension, systematic support for activity design, emerges from integration between test behaviors and the Scoring Guide conceptual structure. Teachers use the six deep approach behaviors as frameworks for designing activities: (1) describing concepts with their own words and detail, (2) creating concrete examples, (3) constructing relational schemas, (4) deepening understanding through additional sources, (5) identifying possible misunderstandings, and (6) designing challenging exercises (Almeida et al., 2024). These behaviors provide concrete operational definitions of what constitutes a deep approach, enabling teachers to design activities that directly promote these behaviors rather than merely hoping they will emerge spontaneously from student activity.

Additionally, TAEPv2 enables the identification and categorization of errors, revealing surface approach adoption. A study with 71 high school students in a socioeconomically vulnerable context identified 389 errors across 426 possible responses (only 2.35% met deep approach criteria). Errors were categorized into types. This error categorization provides objective foundations for precise interventions, supporting process-centered pedagogy (Almeida, Rodrigues, Gomes & Assis, 2025).

These three dimensions converge on a fundamental conclusion: TAEPv2 and its Scoring Guide transform pedagogical practice by introducing conceptual and reflective demands that strengthen pedagogical intent. Completing the Guide mediates between student assessment and teacher development, reorganizing instruction around structured concepts and meaningful relationships with potential to improve learning quality (Gomes, 2023). This transformation represents a paradigm shift from activity-centered to process-centered instruction.

3. Demonstrating the Framework: Lesson Sequence on Adapted Business Model Canvas

To demonstrate how the instructional design framework operates in practice, we present a complete lesson sequence on "Adapted Business Model Canvas for Generating Quality Activities by Adolescents." This content was developed for Brazil's New Upper Secondary Curriculum Life Project course, targeting students aged 14-18. The lesson

sequence illustrates how Scoring Guide completion transforms into concrete instructional design that systematically promotes deep approach behaviors.

3.1 Conceptual Structure: From Business Model to Educational Framework

The content adapts the Business Model Canvas, originally created for strategic business planning, to the educational context. This adaptation required fundamental reconceptualization: shifting focus from profit generation to personal and social value creation. The Scoring Guide completion process revealed five core concepts organized hierarchically.

The central concept states that business models can be adapted to generate quality activities by students. This concept possesses two fundamental properties: (1) viability of transposing business models to the school context, and (2) redefinition of purpose from profit to personal and social value. This central concept establishes the conceptual foundation from which all other concepts derive.

Value Proposition constitutes the most important concept after the central one, serving as a foundation for any activity. Its fundamental properties include: (1) value as activity foundation; without value, planning is unnecessary; (2) need to articulate the author's value with the target audience's values; and (3) identification of less obvious characteristics that amplify proposal relevance, using detective analogy seeking hidden "clues" of value.

Customer Segmentation, developed jointly with Value Proposition, involves target audience identification. Its fundamental properties are: (1) definition of groups based on shared characteristics, and (2) understanding specific values of each segment. This concept recognizes that different audiences may attribute different values to the same activity, requiring careful analysis of each segment's needs and interests.

Customer Relationships refers to building connections with target audiences, depending on previous concepts. Its fundamental properties are: (1) creation and maintenance of bonds, and (2) use of planned strategies to strengthen these relationships. This concept emphasizes that relationships require intentional design and continuous cultivation, not merely spontaneous interaction.

Key Partnerships emphasizes collaboration for activity execution, defining partners as people or entities providing essential support or resources. This concept recognizes that quality activities frequently require external support, making partnership identification and mobilization critical planning components.

This conceptual structure, explicitly delimited through Scoring Guide completion, provides the foundation for all subsequent instructional design. Each lesson activity (50 minutes) directly targets specific deep approach behaviors while maintaining rigorous alignment with this conceptual structure.

3.2 Lesson 1: Conceptual Foundation and Initial Deep Approach Behaviors

The first lesson establishes a conceptual foundation through explicit presentation of the five core concepts and their fundamental properties. Unlike traditional expository lessons that merely present information, this lesson systematically explicates: (a) each concept's fundamental properties, (b) essential relationships among concepts, and (c) logical articulation organizing the conceptual structure. Students receive two support materials: a concept map showing all concepts and their fundamental properties (Figure 3), and a guide to the six deep approach behaviors assessed by TAEPv2 (Figures 4 and 5).

Figure 3: Map of fundamental concepts and properties of the content

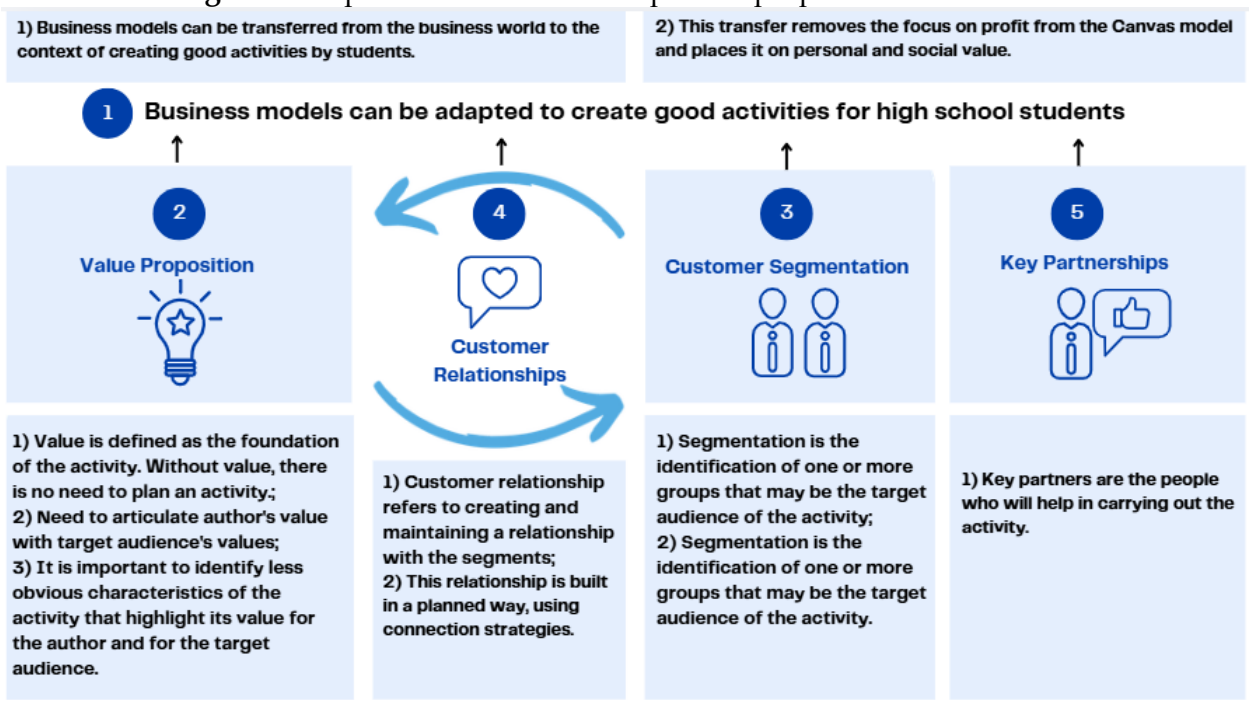

Figure 4: Guide to behaviors 1, 2, and 3 of the Approach-in-Process Test Version 2

Guide	Deep approach behavior 1	Deep approach behavior 2	Deep approach behavior 3
Description	Describe in your own words and in as much detail as possible a concept related to the content taught.	Come up with a concrete example that shows your understanding of a concept.	Create a diagram that clearly shows how the concepts and their fundamental elements relate to each other.
What it is	It is analysis, interpretation, and understanding of concepts. You need to assign meaning to the concept and describe it with personal authorship.	It is the understanding of the existence of the concept in a concrete situation. You need to explain in which part of the concrete example the concept is present.	Create a diagram showing each concept and their relationships, and explain in writing the concepts, their properties, and relationships represented in the diagram.
What it is not	This personal way of describing the concept cannot compromise the correct meaning of each of the concept's fundamental properties. It is not a reproduction of the descriptions of the concept and its fundamental properties given by the teacher or the textbook.	Be careful not to create an abstract example. The example needs to be concrete.	Creating a diagram without explaining the concepts and their relationships. Explaining the concepts in writing without constructing a diagram. Failing to correctly express, in one's own words, the meaning, properties, and relationships of the concepts.

Figure 5: Guide to behaviors 4, 5, and 6 of the Approach-in-Process Test Version 2

Guide	Deep approach behavior 4	Deep approach behavior 5	Deep approach behavior 6
Description	Describe the concept taught that you researched further. Explain, in a clear, structured, and detailed way, how your conceptual understanding developed after the class and how it was deepened after your additional research. Do not forget to indicate the source of information used.	Identify possible misunderstandings about the content taught.	Create the exercise, present its solution, and explain why it encourages reflection and is challenging for you and your classmates.
What it is	It is adding to and expanding your knowledge about a concept in a deeper way. It means "+1": what was learned in class plus what was added through further study. It is necessary to correctly present the understanding of the concept learned in class. It is necessary to show how the concept was deepened through study.	It is the process of mapping errors in your understanding. Even if you believe you have no misunderstanding, the process of mapping possible errors you might make helps you become aware of this possibility.	It is the development of an activity that encourages analysis, reflection, and critical thinking in the student. The student must have a clear understanding of the concepts and their fundamental properties. The exercise requires clear and direct writing that addresses the learned concept. The exercise instructions must be clear and well written. There must be no conceptual misunderstanding in the instructions. It is necessary to answer the exercise correctly. It is necessary to justify why the exercise is challenging.
What it is not	It is not reinforcing only what was already learned. It is not listing doubts about what is not well understood.	It is not listing doubts about understanding.	Creating a drill or memorization exercise that does not challenge reasoning and reflection.

Following the conceptual presentation, the lesson directly promotes three deep approach behaviors. Behavior 2 (creating concrete examples) receives primary emphasis through a detailed example encompassing all concepts and their fundamental properties. The example features Marina, a first-year high school student who wants to create more pleasurable activities at school. Through dialogue with Mathias, a third-year student, Marina learns to apply each concept systematically.

The example demonstrates Value Proposition application: Marina identifies her personal value (creating a pleasant, relaxed school environment) and conducts surveys to verify whether potential audiences (students, elderly community members, teachers) share this value. Survey results reveal that teachers attribute slightly different value (creating an environment making students happier and more motivated to attend school), yet this value remains compatible with Marina's. A second survey on film preferences reveals less obvious characteristics: students prefer action, superhero, and science fiction films, while the elderly prefer romance and period films. This discovery shows that adolescents and the elderly do not share the same value regarding film type, requiring separate activity planning for each segment.

Customer Segmentation emerges naturally: Marina identifies three distinct segments (students, elderly, teachers), each with specific values. Customer Relationships develop through planned interaction strategies: weekly Instagram and WhatsApp posts for students and teachers, weekly visits to the local cultural center for the elderly. Key Partnerships include school administration authorization, student help with room organization, and teacher assistance with film curation.

The example concludes with Marina's complete activity plan organized in a table showing: Partners, Value Proposition, Film, Date, Time, Location, Target Audience, Communication Channel, and Relationship Strategy. This concrete example demonstrates how all concepts integrate in practical application, providing students with a clear model of expected understanding.

The lesson concludes with a homework assignment: students must create their own concrete example highlighting concepts and fundamental properties. This assignment simultaneously promotes Behavior 1 (describing concepts with their own words and detail) as students must comprehend information and reformulate it in their own language rather than mechanically repeating what they learned. It also promotes Behavior 3 (creating relational schema) as students study the concept map showing how fundamental content elements relate.

3.3 Lesson 2: Collaborative Refinement and Peer Assessment

The second lesson promotes the same three deep approach behaviors (1, 2, and 3) through collaborative work. Students form groups of five, and each presents their homework concrete example. Groups vote for the best example, which receives teacher recognition. This voting process requires students to evaluate example quality based on conceptual accuracy and completeness, promoting critical analysis of peer work.

Following voting, groups collaboratively improve the selected example. All members must contribute ideas, consulting the concept map to ensure all fundamental properties are adequately addressed. This collaborative improvement process serves multiple pedagogical functions: (a) exposing students to diverse perspectives on concept application, (b) requiring explicit articulation of conceptual understanding to justify improvement suggestions, (c) promoting negotiation of meaning through dialogue, and (d) developing collective responsibility for learning quality.

Groups complete a structured template organizing their improved example. The teacher collects these templates for correction at home, providing written feedback identifying conceptual errors and areas requiring further development. This feedback prepares the foundation for Lesson 3, which focuses on error identification and correction.

3.4 Lesson 3: Error Identification and Conceptual Refinement

The third lesson introduces Behavior 5 (identifying possible misunderstandings) while reinforcing Behaviors 1, 2, and 3. Students reform their groups from Lesson 2 and receive their corrected templates with teacher feedback highlighting conceptual errors. The teacher circulates among groups, clarifying doubts and ensuring students understand the nature of identified errors.

Groups spend 40 minutes analyzing errors and revising their examples. This process requires: (a) identifying why specific responses constitute errors (e.g., confusing Value Proposition with Customer Segmentation, failing to articulate the author's value

with audience values, omitting fundamental properties), (b) understanding correct conceptual application, and (c) reformulating responses to eliminate errors while maintaining example coherence.

This error-focused work promotes metacognitive awareness. Students must reflect on their own thinking processes, identifying where conceptual understanding broke down. This reflection transforms errors from mere failures into learning opportunities, fostering a growth mindset and resilience. Additionally, analyzing peer errors (since groups work on collectively produced examples) reduces defensive reactions that often accompany individual error correction.

Groups complete new templates with corrected examples, demonstrating their refined understanding. The teacher collects these for final review, though primary learning occurs through the correction process itself rather than through final product evaluation.

3.5 Lesson 4: Public Presentation and Comprehensive Assessment

The fourth and final lesson consolidates the deep approach behaviors through public group presentations. Each group presents their refined concrete example to the class. During presentations, the teacher provides immediate feedback, and audience members consult the concept map to verify whether all fundamental properties are correctly presented.

This presentation structure serves multiple pedagogical functions. First, it requires presenting groups to articulate their understanding clearly and completely, promoting Behavior 1 (describing concepts with their own words and detail). Second, audience members actively engage in assessment, comparing presentations against conceptual standards, promoting critical analysis and reinforcing their own conceptual understanding. Third, when audience members identify inadequately addressed properties, they must present their perspective to the class, requiring explicit articulation of conceptual understanding and justification of their assessment.

This public assessment process creates a learning community where all students share responsibility for learning quality. It transforms assessment from teacher-imposed judgment to collective construction of understanding. Students learn that conceptual accuracy matters not because teachers demand it, but because it enables effective communication and practical application.

4. Discussion: From Activity-Centered to Process-Centered Instruction

The lesson sequence demonstrates a fundamental paradigm shift from activity-centered to process-centered instruction. Traditional active methodologies focus on student activity, assuming that activity inherently generates a deep approach to learning. The empirical evidence refutes this assumption: PBL and other active methodologies produce inconsistent effects on deep approach adoption, with effect sizes ranging from negligible

(d = 0.11) to moderate (d = 0.50), and some studies showing nearly equal distribution between deep and surface approaches (Dolmans et al., 2016; Mogre & Amalba, 2015; Du et al., 2019).

The critical factor is not activity per se, but intentional instructional design targeting specific deep approach behaviors. The TAEPv2 framework enables this intentional design through three mechanisms: (1) explicit delimitation of fundamental properties and essential relationships of key concepts via Scoring Guide completion, (2) operational definition of deep approach behaviors through the six test behaviors, and (3) systematic alignment between conceptual structure and behavioral promotion through activity design.

This framework addresses the gap between pedagogical intentions and concrete interventions. Teachers frequently express intentions to promote deep learning, critical thinking, and conceptual understanding, yet lack systematic methodologies to translate these intentions into specific instructional actions. The Scoring Guide provides this methodology by requiring teachers to make explicit what is often left implicit: the conceptual structure organizing content and the specific behaviors constituting a deep approach.

The lesson sequence illustrates how this explicit structure enables systematic intervention in learning processes. Each lesson activity directly targets specific behaviors while maintaining rigorous conceptual alignment. Lesson 1 establishes conceptual foundation and models Behaviors 1, 2, and 3. Lesson 2 promotes collaborative refinement of these behaviors. Lesson 3 introduces Behavior 5 while deepening previous behaviors through error analysis. Lesson 4 consolidates all behaviors through public presentation and peer assessment. This systematic progression ensures that students engage repeatedly with each behavior across varied contexts, promoting transfer and consolidation.

Additionally, the framework transforms teacher's role from facilitator to systematic interventionist. Rather than merely creating opportunities for student activity and hoping deep learning emerges, teachers design specific interventions targeting identified behaviors, provide structured support for behavior development, monitor student performance against explicit criteria, and adjust instruction based on observed difficulties. This represents more demanding teacher role, requiring deeper content knowledge, pedagogical content knowledge, and metacognitive awareness. However, it also represents more effective role, as evidenced by the consequential validity studies.

The framework also addresses a critical limitation of traditional assessment: its retrospective nature. Traditional assessment evaluates learning after instruction concludes, providing information too late to influence the learning process being assessed. TAEPv2 and its Scoring Guide enable prospective assessment: the Scoring Guide completion process occurs before instruction, shaping instructional design itself. The test behaviors provide ongoing assessment criteria throughout instruction, enabling

continuous monitoring and adjustment. This prospective orientation transforms assessment from judgment tool to learning tool.

Finally, the framework addresses the concept teaching challenge. Research consistently shows that students often acquire superficial, fragmented understanding of concepts, memorizing definitions without grasping fundamental properties and essential relationships (Almeida et al., 2025). The Scoring Guide directly addresses this problem by requiring teachers to explicate fundamental properties and essential relationships, ensuring these become explicit instructional targets rather than remaining implicit expectations. The lesson sequence demonstrates how this explication translates into concrete teaching: Marina's example systematically addresses each concept's fundamental properties, error correction focuses on property omissions or misapplications, and peer assessment uses properties as evaluation criteria.

5. **Conclusion**

This article presented an instructional design framework that enables direct pedagogical intervention in learning processes through the Approach-in-Process Test Version 2 and its Scoring Guide. Unlike conventional approaches focusing on student activity, this framework emphasizes intentional lesson construction targeting deep approach behaviors: describing concepts with one's own words and detail, creating concrete examples, constructing relational schemas, and detecting possible misunderstandings.

The framework operates on three fundamental principles: (1) conceptual clarity through explicit delimitation of fundamental properties and essential relationships of key concepts, (2) behavioral specificity through precise identification of observable behaviors constituting a deep approach to learning, and (3) systematic intervention through deliberate activity design directly promoting these behaviors and enabling continuous learning process monitoring.

Evidence from 13 studies conducted between 2022 and 2025 demonstrates that this framework transforms pedagogical practice across three dimensions: (1) promoting teacher reflection on pedagogical practice through Scoring Guide completion requiring explicit conceptual structure delimitation, (2) enhancing student self-assessment quality through structured support for self-evaluation anchored in objective parameters and external feedback, and (3) systematically supporting activity design that directly intervenes in learning processes through operational definition of target behaviors.

The lesson sequence on Adapted Business Model Canvas demonstrates how this framework translates into concrete instructional practice. Each lesson systematically targets specific deep approach behaviors while maintaining rigorous alignment with explicitly delimited conceptual structure. This systematic progression ensures repeated engagement with each behavior across varied contexts, promoting transfer and consolidation.

The framework represents a paradigm shift from activity-centered to process-centered instruction. Empirical evidence demonstrates that active methodologies alone do not guarantee deep approach adoption, with PBL studies showing inconsistent effects ranging from negligible to moderate. The critical factor is intentional instructional design targeting specific deep approach behaviors, which the TAEPv2 framework enables through explicit conceptual structure delimitation, operational behavior definition, and systematic activity alignment.

This framework addresses fundamental educational challenges: the gap between pedagogical intentions and concrete interventions, the retrospective nature of traditional assessment, and the difficulty of teaching concepts with genuine understanding of fundamental properties and essential relationships. By requiring teachers to make explicit what is often left implicit, conceptual structure and target behaviors, the framework enables systematic intervention in learning processes rather than merely hoping deep approach to learning emerges spontaneously from student activity.

Future research should investigate: (1) framework effectiveness across diverse content areas and educational levels through randomized controlled trials, (2) long-term effects on students' learning approach development and academic achievement, (3) teacher professional development requirements for effective framework implementation, (4) adaptations necessary for different cultural and institutional contexts, and (5) integration with other pedagogical innovations such as formative assessment and differentiated instruction.

The TAEPv2 framework offers educators a methodology for transforming pedagogical intentions into concrete interventions, fostering conceptual understanding and deep approach to learning. By shifting focus from activity to process, from implicit to explicit, and from retrospective to prospective, this framework enables systematic pedagogical intervention in learning processes. the fundamental challenge of education.

Declaration of Conflict of Interest
The authors declare no conflict of interest.

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