RESEARCH ARTICLE

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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"

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ABSTRACT

The theory of students' approaches to learning makes direct contributions to the teaching-learning process. For instance, it provides a conceptual repertoire that helps improve the teacher's pedagogical practice and the student's self-assessment of their own learning. Despite its contributions, the field of approaches has an important limitation: the measurement of its constructs is carried out exclusively by self-report tests. Although these measures have brought advances to the field, self-report is permeated by important biases that impair the quality of measurement. Considering this limitation, the Laboratory for Cognitive Architecture Research (LAICO) has initiated an agenda to develop performance-based tests for the measurement of approaches. The Approach-in-Process Test Version 2 is part of this agenda. It is a performance-based test that measures approach in the context of school/academic learning. In addition to the performance-based measurement, the test has two self-report measurements. The first measures the student's perception of the impact of certain lessons on his or her deep approach to learning. The second measures the student's perception of how often he or she manifests the deep approach to learning. The test items for the self-report measurements are multiple choice, while the items for the performance measure are open-ended in nature and require a correction guide. This paper presents, for the first time, the Correction Guide for the Approach-in-Process Test Version 2. In this paper, all the structural components of the correction guide are shown as well as its application to the specific content "we have no direct access to reality" taught in a particular university discipline. Applications of the Correction Guide in other teaching contents will be presented in future publications. They will show that the Approach-in-Process Test Version 2 can be applied and corrected in the diversity of school/academic contents.

Keywords: approach-in-process test (Version 2), students' approaches to learning, test based on performance.

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I. Introduction

The theory of students' approaches to learning has made an original contribution by defining that student learning, in its various forms, converges on two fundamental approaches: superficial and deep. When approaching superficially, the student uses low-level cognitive processes, such as rote learning, and is mustered by extrinsic reasons and weak commitment. On the other hand, when approaching deeply, the student uses high-level cognitive processes, such as meaning construction, and is mustered by intrinsic reasons, such as curiosity and the desire to improve himself (Gomes, 2010c; 2011a; Gomes & Golino, 2012c; Gomes & Linhares, 2018; Gomes *et al*., 2011, 2021f, 2021g, 2022c; Rodrigues & Gomes, 2020).

The theory of students' approaches to learning brings direct contributions to the teaching-learning process. For instance, it provides a conceptual repertoire that allows improving the teacher's pedagogical practice and the student's self-assessment of their own learning. Despite its contributions, the field of approaches has an important limitation: the measurement of its constructs is carried out exclusively by self-report tests. Although these measures have brought advances to the field, self-report is permeated by important biases that undermine the quality of measurement. For example, self-report requires that the respondent has a good knowledge about his or her own internal processes to make the measure unbiased (Gomes *et al*., 2020f).

By taking this limitation into account, the Cognitive Architecture Research Laboratory (LAICO) at the Federal University of Minas Gerais (UFMG) has initiated an agenda to develop performance-based tests for measuring approaches. LAICO is a research center with expertise in psychometrics and innovative methods (Table I). Its methodological repertoire is used to conduct predictive studies, analyses on the validity of constructs and theories, as well as cognitive interventions (Table II). LAICO has psychoeducational tests and since 2021 they are being made freely and openly available to researchers on the ResearchGate platform (Table III).

TABLE I: PSYCHOMETRICS STUDIES AND INNOVATIVE METHODS

	Studies
Psychometrics	Araújo *et al*., 2018; Casanova *et al*., 2021; Costa *et al*., 2012; Golino & Gomes, 2012b, 2015a, 2015b, 2015c, 2015d, 2015e; Golino *et al*., 2015; Gomes, 2009b, 2011b, 2012a; Gomes & Borges, 2008b, 2008c, 2009a, 2009b; Gomes & Gjikuria, 2017; Gomes & Golino, 2012b; Gomes & Marques, 2016; Gomes & Rozenberg, 2021; Gomes *et al*., 2014d, 2016, 2018a, 2018b, 2020d, 2021d, 2022a; Matos *et al*., 2019; Mecca *et al*., 2015; Monteiro *et al*., 2020; Moura *et al*., 2014; Muniz *et al*., 2016; Pinheiro *et al*., 2009; Pires & Gomes, 2018; Reis *et al*., 2021; Reppold *et al*., 2015; Rosa *et al*., 2013; Salami *et al*., 2021; Silveira *et al*., 2012; Valentini *et al*., 2015
Innovative methods	Ferreira & Gomes, 2017; Golino & Gomes, 2014a; 2014c, 2016; Gomes & Almeida, 2017; Gomes & Golino, 2015b; Gomes & Jelihovschi, 2016; 2019; Gomes & Valentini, 2019; Gomes *et al*., 2013, 2014a, 2017, 2019, 2020a, 2020e, 2021c, 2021e; Haase *et al*., 2010; Jelihovschi & Gomes, 2019; Pires & Gomes, 2017

TABLE II: PREDICTIONS AND CONSTRUCTS RESEARCHED BY LAICO

Tema	Studies
Metacognition and executive functions	Castillo-Diaz & Gomes, 2022; Dias *et al*., 2015; Diaz & Gomes, 2021b; Gomes, 2021a; Gomes & Golino, 2014; Gomes *et al*., 2021a; Laros *et al*., 2014
Motivations, beliefs and perceptions	Alves *et al*., 2012; Costa *et al*., 2017; Fleith & Gomes, 2019; Fleith *et al*., 2020a, 2020b
Performance prediction	Alves *et al*., 2017; Golino *et al*., 2014a, 2021; Gomes, 2005; Gomes & Golino, 2012a; Gomes *et al*., 2020c; Pazeto *et al*., 2019, 2020
Intelligence	Alves *et al*., 2016, 2018; Golino & Gomes, 2014b; Golino et al., 2014b, Gomes, 2010a, 2010b; Gomes & Borges, 2007, 2009c; Gomes & Golino, 2015a; Gomes *et* al., 2014b; Martins *et al*., 2018
Cognitive interventions	Cardoso *et al*., 2019; Gomes, 2002, 2007a, 2007b, 2020a, 2020b; Gomes *et al*., 2008, 2014c; Pereira *et al*., 2019; Ricci *et al*., 2020
Music Therapy	André *et al*., 2016, 2017, 2018, 2019, 2020a, 2020b, 2020c, 2020d, 2020e, 2021a, 2021b, 2021c; Rosário *et al*., 2019, 2020; Sampaio *et al*., 2015
Neuropsychology and health	Gauer *et al*., 2010; Mansur-Alves *et al*., 2021; Rosário *et al*., 2019; Sampaio *et al*., 2015; Silveira & Gomes, 2014; Teodoro *et al*., 2021

The SLAT-Thinking and SLAT-Thinking 2, its enhanced version, are the first two performance-based tests created by LAICO for the measurement of approaches. They measure the reader's learning approaches when identifying an author's thought in a given text. More recently, LAICO has created two new performance-based tests to measure approaches but focusing on the context of school/academic learning: The Approach-in-Process Test and its enhanced version, the Approach-in-Process Test Version 2.

The Approach-in-Process Test Version 2 has six questions with the same structure. All questions have four items, which have different functions for generating three measures, one based on performance and two based on self-report.

At the beginning of each test question the command "consider the lesson(s) on the content of _____" is presented to the student. The content is filled in by the teacher in the underlined space before applying the Approach-in-Process Test Version 2 on his students. This command tells students what content the teacher has taught them that they should consider when answering the test. An example of a question of the Approach-in-Process Test Version is presented below.

Question 1

Consider the lesson(s) on the content of _____

Item 1: Evaluate if you are able to:

Describe in your own words, and in as much detail as possible, a concept about the subject taught: ( ) No ( ) Yes

Item 2: Only if you checked YES, describe the concept in your own words. *Be sure to mention which concept or concepts the description refers to*.

DESCRIPTION:

Item 3: *ONLY if you checked YES*, rate how much you think the *lesson(s) on the content taught mustered you* to have the behavior indicated by item 1. Choose the option below:

( ) No influence, I did everything on my own.	( ) Some influence	( ) Strong influence

Item 4: To answer this item, consider not only the content analyzed, but *consider your daily habit* of attending classes and studying the content of different subjects. How often do you present the behavior indicated by item 1? Choose the option below:

( ) Never or rarely	( ) Depending on the occasion	( ) Very often or always

About the four items in each test question, item 1 asks the student to assess whether he or she is able to perform a certain deep approach behavior in relation to the content defined in the initial command of the question. If the student has selected the "yes" option of item 1, then item 2 demands the student to perform the behavior. Item 2 is open-ended in nature and has a blank space for the students to write their response, which will indicate their performance. The student's written response is evaluated by the teacher in terms of right or wrong. Item 3 will only be answered by the student if she(he) has selected the "yes" option in item 1. Item 3 assesses the student's perception of the impact of certain lessons on her or his performance in item 2. Finally, item 4 assesses the student's perception of the frequency with which she(he) manifests the deep approach behavior presented in item 1. Performance-based measurement is provided by items 2, while self-report measures are provided by items 3 and 4. The reader can consult the full Approach-in-Process Test Version 2 in Portuguese via article by Gomes (2022b). The English version is presented in the article by Gomes *et al*. (2022b).

Since items 2 of the test are open-ended and require correction by the teacher, the first author of this article has prepared a Correction Guide as a technical support for teachers who wish to apply the Approach-in-Process Test Version 2. This article presents for the first time the Correction Guide, as well as its application to a specific teaching content of a given university discipline.

TABLE III: LAICO'S PSYCHOEDUCATIONAL TESTS

Tests	Studies
SLAT-Thinking	Gomes & Nascimento, 2021k
SLAT-Thinking 2	Gomes, 2021b; Gomes & Nascimento, 2021h
Learning Approach Scale	Gomes, 2013, 2022c
Meta-Performance Test	Diaz & Gomes, 2021a
Metacognitive Tests	Golino & Gomes, 2011
Learning Approaches Test in Video Game	Gomes *et al*., 2020b
Approach-In-Process Test	Gomes & Rodrigues, 2021
Inductive Reasoning Developmental Test	Golino & Gomes, 2012, 2019
Inductive Reasoning Developmental Test-Second Revision	Gomes *et al*., 2021b
Student´s Beliefs about Teaching and Learning	Gomes & Borges, 2008a
School Aspirations Questionnaire	Gomes & Gjikuria, 2018
Interest Scale on Reflective Thinking	Gomes, 2022a
Higher-Order Cognitive Factors Kit	Gomes & Nascimento, 2021a, 2021b, 2021c, 2021d, 2021e, 2021f, 2021g, 2021i, 2021j, 2021l, 2021m, 2021n, 2021o, 2021p; Gomes *et al*., 2021g, 2021h, 2021i, 2021j

II. STRUCTURE OF THE CORRECTION GUIDE FOR THE APPROACH-IN-PROCESS TEST VERSION 2

The correction guide has five sections: (1) Definition of the teaching content, (2) Selection and naming of the central concepts, (3) Contextualization, (4) Fundamental properties of the concepts, and (5) Reference response.

The first two sections mark out the teaching content and its concepts. In the first section, the teacher defines the teaching content involved in the guide. In the second section, the teacher selects and names the core concepts that are part of the defined content. To put it literally, the elements of a content are concepts, because any teaching content is a set of abstractions (concepts), so that if the selection and naming of concepts in the second section did not involve only the core concepts, then many elements that are part of the content should be part of this section. It is not of relevance that section 2 has many elements of the content, but only those components (abstractions-concepts) that are central. Normally, the content and its core concepts tend to be pre-defined by the teaching communities related to that content. This does not mean that the teacher may not also create the core concepts of his subject by him or herself. One strategic way for the teacher to assess whether she or he has selected the core concepts for the teaching content well is to check whether the non-core concepts "gravitate" around the core concepts. If so, this indicates that the selection is relevant, as it allows all the concepts in the content to be organized and structured within the set of core concepts.

The third section is purely contextual. Here, the teacher brings forward information that helps to understand the context of the content taught, such as its workload, number of classes, discipline, or course in which the content is inserted.

The fourth section defines and organizes the fundamental properties of the concepts and their relationships. In this section, the teacher clearly shows how the non-core concepts, i.e., not brought in the second section, are articulated to the core concepts. In this section, the teacher also shows how the core concepts are articulated to each other.

Many of the non-central concepts are components or properties that define the central concepts. Then, one might question that if a non-central concept constitutes the central concept, then it should be understood as central. However, a concept is not defined as central or non-central in the Correction Guide by its condition of being a constituent of another concept. In the Correction Guide, if one concept is a function of another, then that concept is non-central, and the latter is central. For instance, suppose that the teacher focuses on teaching the concept of square to his students. She or he may use the concept of four equal sides and the concept of four 90-degree angles. In this context, it can be understood that "four equal sides" and "four 90-degree angles" will be presented by the teacher as a function of teaching the concept of square. Therefore, in this context, the concept of square is the central one and the other two concepts are non-central. It is very important for the reader to understand that a concept can be central in one teaching context and not central in another. Let's take the example of the square. Suppose that the teacher aims to teach the concept of line and wants to use the concept of square as an example in which the concept of line is present. In this case, the concept of line is the central concept, and the concept of square is non-central. In short, the definition of the central and non-central concepts needs to be stipulated by the teacher taking his or her own pedagogical goals as the mandatory basis.

In the fifth section, the teacher constructs a reference answer for each open-ended item on the test, taking into account all the elements she or he has worked out in the previous sections of the guide. This reference answer is used to correct the students' answers (see Tables IV, V, VI, VII, VIII, IX and X).

All responses to open-ended items should be corrected by the teacher as right or wrong only. So that the teacher will not assign partial correctness to the answers in any open-ended item on the test. Some guidelines define the conditions by which the teacher should judge whether the student's answer is right or wrong. We will show these guidelines below, contextualizing them in each of the test questions.

The open-ended item in question 1 requires the student to describe, in her/his own words, one or more concepts of the content taught. To be evaluated as the right answer, the teacher has to notice that the student correctly describes the concept, and that this description is done in the student's own words. This type of response is completely different from a response in which the teacher verifies that the student merely recites literally one or more concepts presented in the textbooks or by the teacher himself in class. However, the teacher has to keep in mind that the student can describe a concept in her or his own words even using terms presented by the teacher in class or in the textbooks. That is, the student does not have to speak completely differently from what is spoken by the teacher or the textbooks used in teaching the content. When describing the concept, it is enough for the student to articulate in a personal way the ideas and terms used by the teacher himself, so that the student's own authorship in describing the concept is noticeable.

An answer is wrong when the student describes the concept in the same words as the teacher or textbook or if the student describes the concept in his own words, but in the wrong way. In other words, it is not enough for the student to describe a

concept in her/his own words. The conceptual description must be correct.

The open-ended item in question 2 demands the student to bring forward a concrete example of one or more concepts from the teaching content. The example described by the student must be concrete. That is, if the student shows a purely abstract example, in which no concrete allusion is exposed, then his answer should be evaluated as wrong. The student may elaborate a concrete example, but present conceptual errors in the description. In this case, this answer should also be evaluated as wrong.

The open-ended item in question 3 asks the student to present her/his global understanding of the content taught by means of a schema. This open-ended item is very important because it allows the teacher to verify how the student identifies the main concepts and integrates them into an organized and conceptually coherent structure.

The answer can only be evaluated as a right answer if the schema presents the main concepts of the content taught and the relationships between them are conceptually correct. In addition, it is necessary that the explanation of the schema corresponds fully to the schema drawn by the student. In other words, the answer will be wrong if the schema drawn represents one thing and the explanation something else.

The teacher should keep in mind that the open-ended item in question 3 is relatively difficult. If any major concept is missing from the outline or is poorly explained, then the answer will be wrong because the student does not demonstrate an adequate structural understanding of the content. Furthermore, even if the student brings forth the key concepts and explains them correctly, the answer will not be right if the student elaborates an inappropriate relationship that compromises conceptual understanding and, as a result, understanding of the structure.

The open-ended item of question 4, in turn, asks the student to deepen her/his knowledge of one or more concepts of the content taught. The item also asks the student to describe what material was used for that task, be it a website, a book, a lecture, etc. The item also requires the student to clearly describe her/his understanding of the selected concept and explain how much depth was achieved in this concept from the material studied. For the answer to be correct, it must necessarily include these requests.

The teacher should also keep in mind that the understanding described by the student before and after the deepening of the knowledge needs to be well written, so that the teacher is able to identify that the student has really deepened her/his understanding. It may happen that the student is misled when assuming that she/he has a deepened understanding. He may merely repeat the concept, without deepening it. He may also assume that he is deepening conceptual understanding, while in reality he is producing a wrong understanding or forming mistaken relationships. She/He can also generate a mere fragment. In this case, she/he may quote a certain material used by her/him, she/he may also quote some content or concept, but not establish any coherent and organized relation with the concept of the content taught. Therefore, the teacher needs to be very attentive to whether the deepening has in fact occurred. If not, the answer should be evaluated as wrong.

The open item of question 5 asks the student to bring forth at least one misconception related to one or more concepts of the content taught. This item is quite interesting because it encourages the student to monitor how she/he is constructing understanding and what are possible paths to misunderstanding. In this item, the student can write about a misunderstanding that she/he or someone else brought forward, just as she/he can ponder about possible misunderstandings. There is a chance that the student assumes that a certain understanding is a misunderstanding, while in fact it is not. Also, the student may show an understanding that is in fact mistaken but justify wrongly why that understanding is mistaken. In such cases, the answer should be evaluated as wrong.

The open-ended item in Question 6 asks the student to create and solve a challenging exercise, as well as justify why it is challenging. This item is interesting because it allows the student to challenge her/his own understanding, provoking it to reach higher levels.

A challenging exercise is one whose resolution mobilizes the student to increase, even to a small degree, his or her knowledge of the content being taught. In other words, the teacher should verify if the exercise allows this “upgrade” in knowledge. To do this, the teacher must take as a reference what she/he has taught the students and verify if the exercise, in some way, allows the student to add knowledge that has not been transmitted.

This item is difficult, because the exercise created by the student needs to be challenging and the answer to the exercise needs to be right. The justification of why the exercise is challenging also needs to be correct. If any of these elements are produced incorrectly by the student, the answer will be wrong. For instance, if the exercise created by the student is focused only on fixing content, and the student argues that the exercise demands the articulation of concepts, the answer should be considered wrong, because merely fixing the content is not a challenge.

There is a demand that occurs in all the open-ended items of the test except for the open-ended item of question 3. It asks the student to explicitly mention which concepts she/he is using to write her/his answer. The reason is because a given teaching content may have several concepts involved. If the student does not explicitly mention what the concepts are, this does not imply that her/his answer should be evaluated as wrong by the teacher. This is because this demand has only the function of facilitating the teacher’s correction and not to characterize the quality of the answer as right or wrong. If the student’s answer is well elaborated and the teacher can identify which concept is involved, then the teacher should evaluate the answer as correct.

We finally point out that the answer written by the student in any open item of the test can only be considered a right answer by the teacher if it is of the student’s own authorship. For example, if the student writes a concrete example identical to the one already presented by the teacher, sketches a schema identical to the one in the textbook, or brings forth an exercise identical to the one shown in class, then there is no authorship by the student and his answer must be considered wrong.

Next, we present the application of the Correction Guide to the teaching content “we have no direct access to reality.”

Each section of the guide is highlighted in italics for the reader's better visualization. We point out that in this application there is only one concept presented in the second section "selection and naming of core concepts." Moreover, this concept is the very teaching content defined in the first section of the guide because, when designing the course, the teacher intentionally defined that certain concepts would form the structure of the content of his subject.

There is no commentary on our part inserted into the text of the next section. The next section presents the application of the Correction Guide in its entirety, that is, as written by the teacher of the course, who is also one of the LAICO researchers.

III. Presentation on How to Apply the Correction Guide

A. Definition of the Content Taught

"We have no direct access to reality."

B. Selecting and Naming the Core Concepts

"We have no direct access to reality."

C. Contextualization

"We have no direct access to reality" is what defines the first unit of the Quantitative Methods course taught by a certain professor. This content is the epistemological principle that underlies the entire course taught by this professor.

The subject is part of the first period of the Psychology course at the Federal University of Minas Gerais, Brazil. It has a workload of 60 hours, taught in 15 four-hour long meetings. The first unit involves four meetings.

D. Fundamental Properties of the Concepts

"We have no direct access to reality" is taught at the beginning of the course in order to prevent the student from understanding quantitative methods as direct representations of reality. The goal of this concept is to show the student that quantitative methods are treatments of reality, not ways of representing it, in essence. This concept is based on three fundamental concepts, summarized in premises 1 and 2 and their respective logical conclusions.

Premise 1: No living being interacts with its external or internal environment without the use of filters.

Premise 2: Every filter treats, that is, alters the stimuli it receives from the environment.

Logical conclusion: Treatment is an obligatory and inexorable part of the living being's relationship with its environment.

The first premise defines that filters are critical for any living being's interaction with reality. To understand this premise, it is necessary to understand the concept of filter. The filter involves a conception that living beings do not absorb reality directly. For example, in naive realism the idea is that the living being absorbs reality as it is. The notion of filter goes in the opposite direction from this perspective and is based on the idea that there is always a mediator between the living being and reality. These mediators are the filters, such as sight, hearing, touch, reason, language, writing, thought, emotion. In short, premise 1 assumes that any way the subject absorbs reality is indirect, that is, it depends on the mediation of a filter.

The second premise brings the idea that the filter transforms any and all stimuli from reality. This transformation occurs in the filter's own relationship with reality. The stimuli from reality are treated by the filter according to the very configurations occurring in it. The moment the filter receives any stimulus from reality, it automatically changes the original stimulus by its own configurations.

The logical conclusion is an implication of the articulation of the two premises in which accessing reality is synonymous with treating it.

Other concepts are also important for understanding the central concept that "we have no direct access to reality." One of them is the concept that there is a reality that is independent of the subject. Although the subject is part of this reality and is constituted by it, this reality does not depend on the subject. This is arbitrarily called objective reality. Another important concept is arbitrarily called subjective reality. This reality is constructed by individuals' filters as they interact with objective reality. There is a dynamic relationship between objective reality and subjective reality because the individual does not have direct access to (objective) reality, so he is a perpetual and constant inventor of subjective reality, a product of his interaction with objective reality.

The concept of model-dependent realism is a strong epistemological perspective in science and is strongly related to the view that "we have no direct access to reality." Model-dependent realism assumes that no theoretical model is able to describe reality as it is. From this perspective, it makes no sense to investigate whether one model is "truer" than another, since no model has the ability to describe (objective) reality as it is. On the other hand, it does make sense to investigate whether one model is better or worse than another, based on some criterion defined by the scientific community.

E. Reference Answers for Open-Ended Test Items

TABLE IV: Reference Answer-Question 1

Open item from question 1	Reference answer
Describe the concept in your own words. *Be sure to mention which concept or concepts the description refers to*	The concept "we have no direct access to reality" determines how living beings are embedded in reality and how they interact with it. All living beings deal with reality through filters, which "transform" reality by capturing it, so that living beings always access it indirectly through the filters. If filters allow living beings to interact with reality, they also prevent them from accessing it directly.

TABLE V: Reference Answer-Question 2

Open item from question 2	Reference answer
Describe in much detail a concrete example. *Be sure to mention which concept or concepts this example refers to*.	The example is about the concept "we have no direct access to reality". When I eat a pastry, it is difficult to think that even the pastry itself is an invented (subjective) reality. The pastry is an object created by the different filters, so I can't have direct access to the stimuli of objective reality that interacted with these filters and were converted into this object we understand as a pastry.

TABLE VI: REFERENCE ANSWER-QUESTION 3

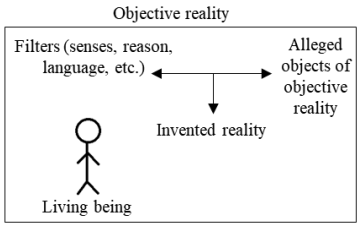
Open item from question 3	Reference answer
Show the outline you designed. Be sure to write a *clear explanation of your outline*, showing your understanding of *each key element* and *how they relate to each other*.	Living beings can live only because of their interaction with objective reality through the filters and their existence cannot be outside of it. The schema shows that objective reality is transformed by filters which create invented (subjective) reality (Fig. 1). Examples of invented reality are light, gravity, heaven, hell, the brain, and nerve synapses, as we understand them. The objects of objective reality are assumed to exist, but it is not possible to know what they are.  Fig 1. Outline explaining the concept "We have no direct access to reality."

TABLE VII: REFERENCE ANSWER-QUESTION 4

Open item from question 4	Reference answer
Describe the concept taught that you sought more information about and deepened your understanding of. *Do this by showing clearly and in detail how your conceptual understanding developed after the lesson(s) and how your conceptual understanding deepened after you sought more information*. Be sure to state the source of the information you used.	The deepened concept is that "we have no direct access to reality." To deepen my knowledge about this concept, I read the book The Grand Design (2010) by Stephen Hawking and Leonard Mlodinow, in which the authors present the proposal they call "model-dependent realism." The excerpt below shows the conception of this proposal: "Model-dependent realism is a term for a philosophical approach to scientific inquiry that approaches scientific laws based on how well the model does in describing the physical reality of the situation. Among scientists, this is not a controversial approach." "What is a bit more controversial, is that model-dependent realism implies that there is no point in discussing 'reality'. Instead, the only meaningful thing that can be said is the usefulness of the model." This idea is totally congruent with the concept that "we have no direct access to reality." I had already understood after the lectures that this congruence existed, but from reading the book I learned that the controversial part of model-dependent realism is precisely the part directly associated with the concept "we have no direct access to reality." In this deepening of my understanding, I concluded that this concept is controversial and puzzles the minds of scientists.

TABLE VIII: REFERENCE ANSWER-QUESTION 5

Open item from question 5	Reference answer
Provide at least one misunderstanding. *Be sure to mention to which concept or concepts this example refers*.	I address the concept "we have no direct access to reality" by pointing out possible misunderstandings. I realized that I held a belief that science would allow me to have direct access to reality. I observed that this belief could get in the way of my understanding of the concept "we have no direct access to reality" since they are contradictory. I became more attentive when learning the concept in order to see whether or not this interference was occurring.

TABLE IX: REFERENCE ANSWER-QUESTION 6

Open item from question 6	Reference answer
Bring forth the exercise, show your solution, and explain why it encourages reflection. *Be sure to mention to which concept or concepts this example refers*.	The exercise refers to the concept "we have no direct access to reality." *Exercise:* Evaluate the sentence highlighted in quotation marks and identify if there are contradictions. If there are, transcribe the passages in which there is contradiction and explain why they contradict each other: "Considering the concept that we have no direct access to reality, when a neuroscientist tests his theory that the brain is responsible for human behavior and obtains solid favorable evidence on that theory, it can be said that this evidence proves it."

TABLE X: REFERENCE ANSWER-QUESTION 6 (CONTINUATION)

Open item from question 6	Reference answer
Bring forth the exercise, show your solution, and explain why it encourages reflection. *Be sure to mention to which concept or concepts this example refers*.	*Answer:* Excerpt 1: "Considering the concept that we do not have direct access to reality..." Excerpt 2: "...it can be said that this evidence proves it." Excerpt 2 contradicts Excerpt 1 because the term "proven theory" is used to express that the theory is true, that is, it describes reality as it is. The epistemologist Karl Popper presents a long argument against the view that a theory can be proven. According to Popper, the empirical world can only allow for the refutation of a theory. In short, he concludes that confirmation is not possible at the empirical level. *Why does exercise stimulate reflection?* To evaluate contradictions is a thought-provoking task because it requires in-depth understanding of the concept. Many people use the term "prove" to say that research results indicate that a theory is true and do not change their way of thinking, even in the context of the concept "we have no direct access to reality".

IV. CONCLUSION

The Approach-in-Process Test Version 2 generates a measure for learning approaches based on student performance. Since items 2 of the test are open-ended in nature, it required the development of a guide so that the correction of the items would be conducted by well-defined and appropriate criteria. This paper presented for the first time the Correction Guide for the Approach-in-Process Test Version 2 and showed its application in a university teaching content.

Applications of the Correction Guide to other teaching content will be brought in future publications. They will show that the Approach-in-Process Test Version 2 can be applied and corrected in a wide range of school/academic content.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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