

Presentation of the Approach-In-Process Test (version 2)

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ABSTRACT

Students' approaches to learning are an important tool used by researchers in the field of educational psychology. The theory assumes that students have two basic ways of approaching objects of knowledge, a deep one and a superficial one. Both are reasonable predictors of academic performance. The study of the learning process requires instruments to be applied to students, nevertheless, the exclusive use of self-report instruments has substantially hindered an adequate study of this process. The Laboratory for Research on Cognitive Architecture (LAICO) at the Federal University of Minas Gerais brought forth an important recent contribution to learning approaches. This is the development of the Approach-in-Process Test (Version 2) which measures the students' process when using their learning approaches. The Approach-in-Process Test (Version 2) is completely original since it is a test based on performance that measures students' learning approach in the academic learning context. In this paper, we make a presentation of the Approach-in-Process Test (Version 2) where we show in detail its structure and content.

Keywords: Academic Learning, Students' Approaches to Learning, Test Based on Performance.

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I. INTRODUCTION

Educational psychology is a field of knowledge deeply associated with the study of human development. Learning, academic performance, retention, dropout, satisfaction, and academic engagement are examples of aspects that are highly valued by educational psychology and that are closely related to the development of the individual (Alves *et al.*, 2016, 2017, 2018; Araújo *et al.*, 2018; Casanova *et al.*, 2021; Fleith & Gomes, 2019; Fleith *et al.*, 2020a, 2020b; Gomes, 2022a; Gomes *et al.*, 2008; Matos *et al.*, 2019; Monteiro *et al.*, 2020). But, educational psychology is not the only one to focus on human development, since its object of study is, by nature, interdisciplinary, involving many areas of scientific knowledge (Table I).

Focusing on human development is not a trivial undertaking. To date, quantitative methods have mostly prioritized models that assume the data to be time independent; even in the case of quantitative methods that support time dependence models, most allow for the measurement of a small amount of repeated measures over time (Gauer *et al.*, 2010; Golino *et al.*, 2015; Gomes, 2020a; Gomes & Gjokuria, 2017; Gomes & Golino, 2012b; Gomes & Jelihovschi, 2016, 2019; Gomes & Valentini, 2019; Gomes *et al.*, 2013, 2017, 2022; Matos *et al.*, 2019). Compared to more traditional methods, there is far less use of algorithms that do not assume time independence (Gomes & Almeida,

2017; Gomes *et al.*, 2019, 2020a, 2020e). This whole trend also occurs in psychological and educational test construction methodologies, where there is a high concentration of methodologies that focus on cross-sectional data collection (Golino & Gomes, 2012, 2014a, 2014c, 2015a, 2015c, 2015d, 2015e, 2016; Golino *et al.*, 2021; Gomes, 2012a; Gomes & Borges, 2008a, 2008b, 2009a; Gomes *et al.*, 2016, 2018, 2020d, 2020e, 2021d 2021e; Pinheiro *et al.*, 2009; Pires & Gomes, 2017, 2018; Reis *et al.*, 2021). In short, those time independence conditions have hindered a richer interaction between the practice of teaching and learning assessment and the pedagogical or cognitive interventions, since the assessment should not only be used as an indicator of the pre- and post-test level of individuals who have or have not experienced a certain pedagogical or cognitive intervention but should also be used as an information at the service of the intervention itself, to the extent that it comes to provide relevant information about the change process itself (Cardoso *et al.*, 2019; Gomes, 2007a, 2007b, 2014b, 2020b; Pereira *et al.*, 2019; Ricci *et al.*, 2020; Rodrigues & Gomes, 2020).

TABLE I: EXAMPLES OF AREAS STRONGLY FOCUSING ON THE STUDY OF HUMAN DEVELOPMENT

Areas	Studies
Developmental psychology	Golino & Gomes, 2019; Golino <i>et al.</i> , 2014b; Martins <i>et al.</i> , 2018
Neuropsychology	Cardoso <i>et al.</i> , 2019; Dias <i>et al.</i> , 2015; Haase <i>et al.</i> , 2010; Mecca <i>et al.</i> , 2015; Pazeto <i>et al.</i> , 2019, 2020; Reppold <i>et al.</i> , 2015
Musicotherapy	André <i>et al.</i> , 2016, 2017, 2018, 2019, 2020a, 2020b, 2020c, 2020d, 2020e, 2021a, 2021b, 2021c; Rosário <i>et al.</i> , 2019, 2020; Sampaio <i>et al.</i> , 2015
Public health	Costa <i>et al.</i> , 2012; Gomes & Rozenberg, 2021; Mansur-Alves <i>et al.</i> , 2021; Moura <i>et al.</i> , 2014; Rosa <i>et al.</i> 2013; Salami <i>et al.</i> , 2021; Teodoro <i>et al.</i> , 2021

TABLE II: PREDICTORS OF ACADEMIC PERFORMANCE

Predictors	Studies
Motivation and beliefs	Alves <i>et al.</i> , 2012; Costa <i>et al.</i> , 2017; Gomes & Borges, 2008a; Gomes & Gjokuria, 2018; Gomes & Marques, 2016; Gomes, 2014d
Intelligence	Golino & Gomes, 2012, 2014b; Golino <i>et al.</i> , 2014; Gomes, 2010b, 2011b, 2012b; Gomes & Borges, 2007, 2008c, 2009b, 2009c; Gomes & Golino, 2012a
Metacognition	Castillo-Diaz & Gomes, 2022; Diaz & Gomes, 2021a, 2021b; Golino & Gomes, 2011; Gomes, 2021a; Gomes & Golino, 2014; Gomes <i>et al.</i> , 2014b, 2021a

The essence of any study of human development involves the investigation of changes, either short or long-term. A developing organism, in theory, is basically a system that changes from one state to another state, implying, in most cases, a qualitative or quantitative change in its structure (Ferreira & Gomes, 2017; Gomes *et al.*, 2014a, 2018; Jelihovschi, & Gomes, 2019). Student learning is a process of change that entails micro alterations, i.e., micro developments throughout a process, and its study demands quantitative methods and models that take into account the time influence of knowledge and students' prior learning on their current learning (Ferreira & Gomes, 2017; Gomes *et al.*, 2014a, 2018; Jelihovschi, & Gomes, 2019). Methodologically, an adequate evaluation of teaching and learning demands the use of tools that capture information about these changes over time, in order to allow, for example, to verify how teaching and certain pedagogical practices mobilize the student and activate certain learning approaches, in order to provide deeper or superficial forms of knowledge acquisition.

The theory of learning approaches is well suited as a conceptual guide for the processual study of teaching and learning practices and their relationship to each other (Gomes *et al.*, 2021f; Rodrigues & Gomes, 2020). The theory assumes that students have two basic ways of approaching objects of knowledge, a deep one, using high-order cognitive processes and intrinsic motivations, and a superficial one, using low-order cognitive processes and extrinsic motivations (Gomes & Linhares, 2018).

TABLE III: BAFACALO'S STUDIES

	Studies
BAFACALO's evidence of internal and external validity	Alves <i>et al.</i> , 2012; Golino & Gomes, 2014b; Gomes, 2010a, 2010b, 2011b, 2012b; Gomes & Borges, 2009b, 2009c; Gomes <i>et al.</i> , 2014a, 2014c; Gomes & Golino, 2012a, 2012c, 2015b;
BAFACALO's tests	Gomes & Nascimento, 2021a, 2021b, 2021c, 2021d, 2021e, 2021f, 2021g, 2021i, 2021j, 2021l, 2021m, 2021n, 2021o, 2021p; Gomes <i>et al.</i> , 2021a, 2021b, 2021c, 2021d

The field which studies approaches has brought important contributions to students' learning approaches, as well as the relationship between teaching, in its different forms, and learning (Gomes, 2010c, 2011a, 2013; 2022b; Gomes & Golino, 2012c; Gomes & Linhares, 2018; Gomes *et al.*, 2011, 2020b; Rodrigues & Gomes, 2020). Evidence has shown that the deep and surface approaches are reasonable predictors of academic performance, with similar predictions to other psychoeducational variables related to motivation, beliefs, and conceptions, despite being secondary predictors if compared to intelligence or metacognition (Table II).

Despite the possibilities brought by the theory of learning approaches for the study of processes related to teaching-learning interaction, the exclusive use of self-report instruments has substantially hindered an adequate study of this process. This involves both the study of approaches used by students in their learning process and the investigation of the extent to which certain teaching methods and pedagogical techniques foster the way students process certain learning approaches.

The Laboratory for Research on Cognitive Architecture (LAICO) at the Federal University of Minas Gerais has as one of its missions to create and validate tests capable of providing rich information about constructs in psychology and education. An important initiative created in 2021 has involved making available, for research purposes, all the tests built by LAICO to the community. Currently, the intelligence battery called BAFACALO is available, with its 18 tests (see Table III). Insofar, as LAICO has a large body of research on intelligence, as well as its relation to academic performance and cognitive development (Golino & Gomes, 2012, 2019; Golino *et al.*, 2014b; Gomes, 2002, 2005, 2007a, 2007b, 2010a, 2020b; Gomes & Borges, 2007, 2008c; Gomes & Golino, 2012a; Gomes *et al.*, 2014b, 2021b; Laros *et al.*, 2014; Muniz *et al.*, 2016; Pereira *et al.*, 2019; Ricci *et al.*, 2020; Valentini *et al.*, 2015).

LAICO brings two important recent contributions to learning approaches. The first was the creation in 2018 of the first approaches test that is based on students' performance rather than self-report (Gomes & Linhares, 2018; Gomes *et al.*, 2020f, 2021g) and its improved version, the SLAT-Thinking 2, capable of identifying procedural types of errors (Gomes, 2021b; Gomes & Nascimento, 2021h, 2021k).

The second is the development of the Approach-in-Process Test (Gomes & Rodrigues, 2021) and in 2022 the Approach-in-Process Test (Version 2) which measures and collects rich information about students' processes when using their

learning approaches in the academic learning context. This test based on achievement permits educational psychology to have a methodology with an adequate tool for the investigation of student development and the process of change. Clinical psychology has a tradition of methods to search for change processes and some of them permit the quantification of processes (Silveira & Gomes, 2014; Silveira *et al.*, 2012). In a way, the Approach-in-Process Test (Version 2) integrates a “clinical” perspective for the process of studying the teaching-learning relationship. Previously, LAICO had already created a Brazilian self-report test, the EABAP, for measuring approaches, supported by an item structure and response options similar to international instruments (Golino & Gomes, 2014b; Gomes, 2010c, 2011a, 2013; Gomes & Borges, 2008a; Gomes & Golino, 2012c; Gomes *et al.*, 2011, 2020b).

II. BRIEF PRESENTATION OF THE TEST APPROACH-IN-PROCESS VERSION 2

The Approach-in-Process Test Version 2, created in 2022 by Cristiano Mauro Assis Gomes and Marina Nogueira dos Santos Rodrigues, was designed for the teacher him/herself to be able to evaluate whether a student applies deep or superficial approach behaviors to learn the content of his/her subject. The test is also an instrument for the student's own self-assessment, providing him/her with increased knowledge and power of action over his/her own learning processes.

The Approach-in-Process Test Version 2 is very innovative and original since it is a test based on achievement that evaluates student learning approaches when learning the content of a subject. The test can be used to assess the use of learning approaches in relation to the content taught in a single lesson. It can also be used to assess the use of student learning approaches facing a set of several lessons or even the content of an entire subject.

The test has 6 questions. Each question is made up of:

An opening sentence that shows the student what content taught by the teacher he/she must consider in order to take the test.

1. Item 1, asks the respondents to evaluate whether they are able to perform the learning approach highlighted in bold. The respondent must select the option “yes” or “no”.
2. Item 2, asks the respondent to perform the learning approach if he/she selected the “yes” option from item 1.
3. Item 3, asks the respondent to rate how well the lesson(s) mustered him/her to perform the learning approach in item 2 if he/she answered the “yes” option of item 1. He/she must select one of three response options.
4. Item 4, asks the respondent to describe how often he/she displays the learning approach described in item 1, regularly and independently of the content lesson/s taught and involving the test. He/she must select one of three response options.

The test generates scores for items 2, 3, and 4 of each of the 6 questions. The score for item 2 is the most important because this is the performance-based score that makes the Approach-in-Process Test Version 2 a first-of-its-kind test to

assess learning approaches of school/academic content through student performance. The score for item 2 is as follows. If the student assesses on item 1 that he/she is unable to perform the required learning approach highlighted in bold, then his/her score on item 2 is zero (0). If the student assesses in item 1 that he/she is able to perform the learning approach, but in item 2 he performs a wrong performance, then his score in item 2 is 1 point. Only if the student performs item 2 correctly, then his score on this item will be 2 points. The score for item 2 of each of the 6 questions measures the surface approach and the deep approach in a continuum. Higher scores imply a higher deep approach and lower scores imply a higher surface approach. Item 3 generates a score about the student's perception of the influence of the lesson/s on his/her ability to perform the learning approach requested by item 1. If the student selects the answer option “no influence, I did it on my own”, then his/her score on item 3 will be zero (0). If the student selects the option “Some influence”, then his or her score is 1 point on item 3. If the student selects the option “Strong influence”, then his or her score is 2 points on item 3. This item is a self-report score and is not performance-based. Item 4 generates a score about the student's perception of how often he/she routinely exhibits the learning approach presented in item 1. If the student selects the option “Never or rarely”, then his/her score on item 4 is zero (0). If he selects the option “Depends on the occasion”, his score is 1 point on item 4 and if he selects the option “Often or Always” his score is 2 points. This item is also a self-report score and is not performance-based.

LAICO provides support to teachers who wish to apply the test, especially with respect to the construction of a correction guide for the evaluation of student performance in item 2 of the 6 questions of the test, considering that performance evaluation requires the elaboration of well-defined criteria so that student performance is correctly scored. In the future, LAICO will present examples of correction guides involving different school-academic contents. Below, we will present the Test Approach-in-Process Version 2 in its entirety.

III. APPROACH-IN-PROCESS TEST VERSION 2 (DIRECTIONS)

You may exhibit learning behaviors that help or hinder you in learning the content of a certain subject.

The Test Approach-In-Process (version 2) is designed to generate information about some of these behaviors.

The most important idea is that the test can serve as information for yourself, giving you greater knowledge and power of action over your own learning processes.

The test consists of only 6 questions and each question presents a learning behavior.

The following example shows how to answer the test.

A. Example

1) Question X

Comment: All 6 questions in the test define the content(s) of a particular subject that you have to consider in order to answer the test. The content is defined in the command highlighted in bold and may involve just one lesson or a set of lessons or even the whole subject content. In our example, the content of the test will involve only one biology lesson in

which the teacher taught the concept of sexual reproduction. Hence the command in bold reads as follows:

Consider the lesson(s) on “sexual reproduction” content.

Item 1: Evaluate whether you are able to:
Develop a concrete example that shows your understanding of a concept: () No (X) Yes

Comment: Note that item 1 asks you to assess whether you are able to “come up with a concrete example that shows your understanding of a concept”. You should consider whether you can do this, but related to the “sexual reproduction” content you have been taught. This is the content you must consider.

Comment: Suppose that a student answers the test and evaluates that he is able to do that for the content in question; then he marks the “Yes” option of item 1. Otherwise, if he thinks he is not able, he marks the “No” option of item 1.

Comment: You will only answer items 2 and 3 if you mark “Yes” to item 1 of any test question. Otherwise, you must go straight to item 4 and answer it.

Item 2: Only if you checked YES, describe as detailed as possible a concrete example. *Be sure to mention to which concept or concepts this example refers.*

Comment: Since in the example our student checked “Yes” in item 1, then he will present a concrete example in item 2. When answering item 2, you should answer as best you can, expressing your understanding of the concept taught. In the case of our example, the only concept taught was sexual reproduction; however, there may be situations in other tests where there is more than one content or concept; in this case, you can choose which concept you prefer to present and work on in item 2. We leave, below, the description of our student.

Description:

“The concept of my concrete example is that of sexual reproduction. The teacher has taught that sexual reproduction is reproduction in which there is an exchange of genetic material between living things, while asexual reproduction is reproduction without an exchange of genetic material. So, these concepts are not necessarily related to the presence of copulation. So I thought about the ways in which a starfish can reproduce. When the female releases her eggs into the water and the male releases his sperm, the gametes meet in the water, without copulation of the progenitors. This would be a concrete example of sexual reproduction, because in fertilization there is an exchange of genetic material between the gametes. On the other hand, the starfish can suffer an accident and be broken in half. Each half can undergo regeneration, forming two new stars. In this case, because there is no exchange of genetic material, the star has made an asexual reproduction.”

Item 3: Only if you marked YES, please 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

(X) Strong influence

Comment: Suppose that our student thinks the lesson strongly mustered him to think of concrete examples related to the taught concept. So, she/he answers item 3 by marking an X in the “strong influence” option.

Comment: Suppose that our hypothetical student believes that the behavior of the question, that is, of “coming up with a concrete example that shows hers/his understanding of a concept” is something that is present in his everyday life depending on the occasion. Therefore, she/he marks an X in the “Depends on the occasion” option of item 4.

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

() Never or rarely

(X) Depending on the occasion

() Very often or always

Having read and understood the directions, you may begin taking the test on the next page.

IV. APPROACH-IN-PROCESS TEST VERSION 2

A. 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
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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
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Question 2

Consider the lesson(s) on the content of _____,

Item 1: Evaluate if you are able to:

Develop a concrete example that shows your understanding of a concept.	☐ No	☐ Yes
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Item 2: **ONLY if you checked YES**, describe in much detail a concrete example. *Be sure to mention which concept or concepts this example 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
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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
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Question 3

Consider the lesson(s) on the content of _____,

Item 1: Evaluate if you are able to:

To bring forth an outline in which you clearly show how the fundamental elements of the taught content relate to each other.	☐ No	☐ Yes
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Item 2: **ONLY if you checked YES**, 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*.

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
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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
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Question 4

Consider the lesson(s) on the content of _____,

Item 1: Evaluate if you are able to:

Sought more information and deepened your knowledge on the subject, by searching the Internet, reading books, watching documentaries, etc.	☐ No	☐ Yes
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Item 2: **ONLY if you checked YES**, 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.

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
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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
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Question 5

Consider the lesson(s) on the content of _____,

Item 1: Evaluate if you are able to:

Identify possible misunderstandings about the taught content.	☐ No	☐ Yes
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Item 2: **ONLY if you checked YES**, provide at least one misunderstanding. *Be sure to mention to which concept or concepts this example refers.*

EXAMPLE:

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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
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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
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Question 6

Consider the lesson(s) on the content of _____,

Item 1: Evaluate if you are able to:

Create a challenging exercise that encourages reflection on a learned concept.	☐ No	☐ Yes
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Item 2: **ONLY if you checked YES**, 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.*

DESCRIPTION:

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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
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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
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V. CONCLUSION

This study presented the Approach-in-Process Test Version 2. This test brings an original contribution to the field of students' approaches to learning since it is a test based on performance in the academic learning context. The test was designed for the teacher him/herself to be able to evaluate the deep and surface approaches while the students learn a specific content of his/her subject. Furthermore, the Approach-in-Process Test Version 2 is also an instrument for the student's own self-assessment, providing him/her with increased knowledge about his/her own learning processes. The Approach-in-Process Test Version 2 is a tool created by LAICO that is freely available to any interested researcher or teacher. As already mentioned, LAICO provides support to those who wish to apply the test, especially with respect to the construction of a correction guide for the evaluation of student performance items of the test.

CONFLICT OF INTEREST

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

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