

The Presentation of Interest Scale on Reflective Thinking and its Internal and External Validity

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ABSTRACT

Studies on prediction recognize the presence of a large number of predictors of school-academic performance, as well as the existence of well-established predictors, nevertheless some psychoeducational variables remain little explored, even though their great potential. One of these is reflective thinking. The Laboratory for Research on Cognitive Architecture (LAICO) at the Federal University of Minas Gerais brought forth a contribution to reflective thinking. This is the development of the Interest Scale on Reflective Thinking which measures the interest of people in thinking reflectively. In this paper we present the Interest Scale on Reflective Thinking where it is shown in detail its structure and content. We also show evidence of structural validity, external validity and reliability of the scale.

Keywords: Interest in Reflective Thinking, Test Based on Self-Report, Validity.

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I. INTRODUCTION

The prediction of academic performance is a topic of great importance in education and related areas. So that variables, such as socioeconomic status, family, intelligence, metacognition, motivation, cognitive styles, beliefs, and learning approaches, have been investigated as potential predictors of student performance (Table I).

Predictors such as socioeconomic status and intelligence have already a solid evidence base regarding their predictive role on academic performance. However, some psychological constructs with less solid bases have potential relevance and are worthy of investigation. One such construct is reflective thinking. Forming reflective students is a very important goal in educational discourse, as reflective thinking is one of the foundations for the formation of a critical citizen.

As far as we know, the Questionnaire for Reflective Thinking is the first test of reflective thinking. It was introduced by Kember *et al.* (2000) and measures levels of reflective thinking and has been used as a reference by researchers in the field. Since the Kember *et al.* (2000) instrument is focused on student reflective thinking, particularly in the university context, efforts have been made to create new instruments capable of measuring reflective thinking in other contexts. The Interest in Reflective Thinking Scale is part of this initiative and seeks to measure how interested a person is in thinking reflectively.

II. INTEREST IN REFLECTIVELY THINKING SCALE (BACKGROUND)

The Interest in Reflectively Thinking Scale is part of an initiative by the Research on Cognitive Architecture (LAICO) at the Federal University of Minas Gerais to construct well-designed tests with good psychometric properties, validate, and make them openly available, free of charge to researchers (Table II). LAICO is a reference center in Brazil for test construction and validation (Table III), cognitive intervention studies (Table IV), and data analysis involving state-of-the-art techniques in psychometrics and machine learning (Table V).

TABLE I: ACADEMIC ACHIEVEMENT PREDICTORS

Areas	Studies
Socioeconomic Level and Family	Alves <i>et al.</i> , 2016, 2017, 2018; Martins <i>et al.</i> , 2018; Pazeto <i>et al.</i> , 2019, 2020
Intelligence	Alves <i>et al.</i> , 2016, 2018; Gomes & Golino, 2012a; Laros <i>et al.</i> , 2014; Martins <i>et al.</i> , 2018
Metacognition	Castillo-Díaz & Gomes, 2022; Gomes, <i>et al.</i> , 2014b
Motivation, Cognitive Styles, Beliefs and Learning Approaches	Alves <i>et al.</i> , 2012; Gomes, 2010c, 2011a; Gomes & Golino, 2012c; Gomes, <i>et al.</i> , 2014, 2022b; Rodrigues & Gomes, 2020

TABLE II: LAICO'S TESTS ALREADY PUBLIC WITH OPEN AND FREE ACCESS SINCE 2021

Studies	
Battery of High-Order Cognitive Factors (BAFACALO)	Gomes & Nascimento, 2021a, 2021b, 2021c, 2021d, 2021e, 2021f, 2021g, 2021i, 2021j, 2021l, 2021m, 2021n, 2021o, 2021p; Gomes, <i>et al.</i> , 2021g, 2021h, 2021i, 2021j
Learning Approaches Scale (EABAP)	Gomes, 2022c
Interest in Reflective Thinking Scale	Gomes, 2022a
In-Process Approach Test Version 2	Gomes, 2022b; Gomes <i>et al.</i> , 2022c

TABLE III: LAICO'S WORK INVOLVING THE CONSTRUCTION AND/OR VALIDATION OF TESTS

Studies	
Music Therapy	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
Psychology	Araujo & Gomes, 2022; Casanova <i>et al.</i> , 2021; Costa <i>et al.</i> , 2017; Diaz & Gomes, 2021a, 2021b; Fleith & Gomes, 2019; Fleith <i>et al.</i> , 2020a; Golino & Gomes, 2011, 2012, 2014b, 2019; Golino <i>et al.</i> , 2014b, 2021; Gomes, 2005, 2010a, 2010b, 2011b, 2012a, 2012b, 2013, 2021a, 2021b, 2022a, 2022b; Gomes & Borges, 2007, 2008a, 2008c, 2009b, 2009c; Gomes & Gjikuria, 2018; Gomes & Linhares, 2018; Gomes & Marques, 2016, Gomes & Nascimento, 2021h, 2021k; 2022; Gomes & Rodrigues, 2021; Gomes & Rozenberg, 2021; Gomes <i>et al.</i> , 2011, 2020a, 2020f, 2021a; 2021b, 2021g; Mecca <i>et al.</i> , 2015; Muniz <i>et al.</i> , 2016; Pinheiro <i>et al.</i> , 2009; Silveira & Gomes, 2014; Silveira <i>et al.</i> , 2012
Education	Gomes & Borges, 2008b, 2009a; Gomes, <i>et al.</i> , 2014d, 2016, 2018b, 2020d, 2021d; Matos <i>et al.</i> , 2019; Pires & Gomes, 2017, 2018
Health	Costa <i>et al.</i> , 2012; Moura <i>et al.</i> , 2014; Reis <i>et al.</i> , 2021; Rosa <i>et al.</i> , 2013; Salami <i>et al.</i> , 2021

TABLE IV: STUDIES ON COGNITIVE INTERVENTION

Studies	
Cardoso <i>et al.</i> , 2019; Gomes, 2002, 2007a; 2007b, 2020a, 2020b; Gomes, <i>et al.</i> , 2008, 2014c; Pereira <i>et al.</i> , 2019; Ricci <i>et al.</i> , 2020	

TABLE V: LAICO WORKS INVOLVING STATE-OF-THE-ART APPLICATIONS OF PSYCHOMETRICS AND MACHINE LEARNING

Areas	Studies
Psychology and Education	Araújo <i>et al.</i> , 2018; Fleith <i>et al.</i> , 2020b; Golino & Gomes, 2014a, 2014c, 2015a, 2015b, 2015c, 2015d, 2015e, 2016; Golino <i>et al.</i> , 2014a, 2015; Gomes, 2022c; Gomes & Almeida, 2017; Gomes & Gjikuria, 2017; Gomes & Golino, 2012b, 2014, 2015a, 2015b; Gomes & Jelihovsch, 2016, 2019; Gomes & Valentini, 2019; Gomes <i>et al.</i> , 2013, 2014a, 2017, 2018a, 2019, 2020a, 2020c, 2020e, 2021c, 2021e; Haase <i>et al.</i> , 2010; Jelihovsch & Gomes, 2019; Mansur-Alves <i>et al.</i> , 2021; Monteiro <i>et al.</i> , 2020; Reppold <i>et al.</i> , 2015; Teodoro <i>et al.</i> , 2021; Valentini <i>et al.</i> , 2015
Neuropsychology and Health	Dias <i>et al.</i> , 2015; Ferreira & Gomes, 2017; Gauer <i>et al.</i> , 2010

The Interest in Reflectively Thinking Scale was created in 2007 by Cristiano Mauro Assis Gomes in order to measure people's interest in thinking reflectively. The scale uses as a conceptual reference the perspective discussed in Kember *et al.* (2000) that reflective thinking can be understood as the active action of the subject for exploring and deepening his/her learning experience in relation to a given content.

The Scale is a test based on self-report with 8 items. Each item describes a behavior that represents interest in thinking reflectively. The items are rated by the respondent in terms of how well the described behavior represents the respondent's own behavior. To evaluate each item, the respondent chooses one of five options: (1) not at all; (2) a little; (3) more or less; (4) very much; (5) totally. This numbering of the multiple-choice options also corresponds to the raw score for each item. The scale is very flexible, as it can be applied in different contexts, and is not restricted to the school context only. The only requirement is that it be applied to people who have completed at least the fifth grade of elementary school.

The Scale is not openly and freely available to researchers in the English language and there are no publications on the validity and reliability of the Scale up to date, so in this article we present the Scale in its entirety in the English language, and also show the first evidence of structural validity, external validity, and reliability.

III. SCALE OF INTEREST IN REFLECTIVE THINKING (FULL PRESENTATION)

This is a test of your interest in thinking reflectively. In this test, you should rate each item in terms of how much it says about your own behaviors. To do this, use the scale below.

Scale:

- (1) Not at all.
- (2) A little.
- (3) More or less.
- (4) A lot.
- (5) Totally.

Look at the example below:

1. I like games that require me to think before I act to get it right. ()

If this behavior is not present at all, then you should fill in the parentheses with the number 1. If this behavior is somewhat present, then you should fill in the parentheses with the number 2. If this behavior is more or less present in your life, then you should fill in the brackets with the number 3. If this behavior is very present in your life, then you should fill in the parentheses with the number 4. And if this behavior is totally present in your life, then you should fill in the parentheses with the number 5.

Answer the items below:

1. I really like to discuss my thinking about things. ()
2. I like to read about things such that I have to think and reflect on them. ()
3. I am interested in activities that I can think about. ()
4. I like texts in which the author proposes a new idea, which challenges things already known. ()
5. I like to create my own ideas about things. ()

6. Activities where I just have to do things, without thinking, annoy me. ()
7. I like to debate subjects where different people have different ideas about the same thing. ()
8. I see myself as a thinker. ()

IV. EVIDENCE OF VALIDITY AND RELIABILITY

A. Method

The Interest in Thinking Reflexively Scale was applied to 716 students (379 female) from sixth to twelfth grade in a private school in Belo Horizonte, Minas Gerais, Brazil. The scale was applied collectively in 19 classes in 2008, following all research ethics procedures. The school provided the researchers with the students' annual school grades in math, Portuguese, geography, and history. These grades can range from 0 to 100 points.

Structural and external validity were assessed using confirmatory factor analysis of items and structural equation modeling, respectively. Models were estimated using Weighted Least Square Mean and Variance (WLSMV).

The measurement model tested for structural validity analysis of the Scale assumes that the eight Scale items are loaded by the latent variable Interest in Reflective Thinking. External validity, on the other hand, is assessed through a structural model that encompasses the measurement model of the scale and adds as observable variables the students' annual school grades in the subjects of mathematics, Portuguese, history, and geography, it also adds a latent variable of general academic performance that directly loads these school grades. The model also allows for the correlation between math and Portuguese grades. Finally, the model assumes that the latent variable of interest in thinking reflectively loads the latent variable of overall school performance.

Both the measurement model and the structural model are evaluated using the Comparative Fit Index (CFI) and the Root Mean Square Error of Approximation (RMSEA). Only models with $CFI \geq 0.90$ or $RMSEA < 0.10$ were not rejected. Cronbach's alpha and McDonald's omega were used to inspect measurement reliability. We considered as minimally adequate reliability a value of 0.60 or greater for both the alpha and the omega. Descriptive analysis was performed using the psychological package R (Revelle, 2022), while item factor analyses and structural equation modeling were performed using semTools (Jorgensen *et al.*, 2022), lavaan (Rosseel, 2022), and semPlot (Epskamp, 2022).

B. Results

The results show that most of the students' responses on the Scale items were concentrated near the mean (Table VI). Nevertheless, all response categories were selected by the respondents in all items, with a minimum of 1 point and a maximum of 5 points. The average score for the items ranged from 2.71 to 3.91 (Table VI).

The measurement model was not rejected, $[20] = 68.107$, $CFI = 0.991$, $RMSEA = 0.060$ [CI 90%, .045-0.076]. The mean of the factor loadings was 0.643 (SD = 0.116), with a minimum factor loading of 0.420 and a maximum of 0.779. With these results, we may state that the Scale exhibits structural validity.

TABLE VI: DESCRIPTIVE STATISTICS OF THE OBSERVABLE VARIABLES

variables	N	Mean	SD	Skew	Kurtosis	min	max
Item 1	714	3.61	1.21	0.69	-0.32	1	5
Item 2	699	3.20	1.18	-0.23	-0.76	1	5
Item 3	704	3.33	1.10	-0.28	-0.53	1	5
Item 4	698	3.54	1.13	-0.50	-0.47	1	5
Item 5	695	3.91	1.11	-0.97	0.27	1	5
Item 6	686	2.71	1.13	0.25	-0.52	1	5
Item 7	689	3.77	1.10	-0.78	0.00	1	5
Item 8	684	3.00	1.24	-0.03	-0.90	1	5
Mat	704	72.65	12.70	-1.33	4.04	17.3	80.3
Port	704	69.17	10.74	-1.33	4.53	19.0	75.0
Geo	704	74.98	11.08	-1.35	4.24	23.0	76.6
Hist	704	73.32	11.73	-1.61	5.53	15.1	82.3

Note: SD = standard deviation, min = minimum, max = maximum, Mat = Math, Port = Portuguese, Geo = Geography, Hist = History, N = sample.

The alpha and omega for the latent variable of interest in thinking reflectively were 0.82 and 0.83, respectively, indicating that the Scale measure is reliable.

Fig. 1 shows the structural model, factor loadings and correlations. The model was not rejected, $[53] = 73.607$, $CFI = 0.992$, $RMSEA = 0.024$ [CI 90%, 0.007-0.037] and indicates that the latent variable interest in thinking reflectively has statistically significant predictive power ($p = 0.003$) relative to the latent variable general academic performance, with a standardized beta of 0.130 and a $R^2 = 1.7\%$ relative to the outcome variable. In summary, the results allow us to affirm that the Scale presents external validity.

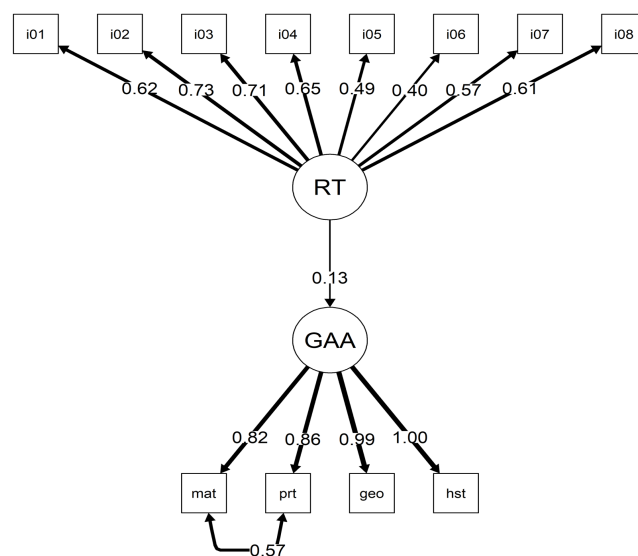


Fig. 1. Structural model, factor loadings and correlations.

V. CONCLUSION

This study outlined a novel self-report-based test for measuring interest in reflective thinking. This test is flexible in that it can be applied in different contexts and to people who have at least completed fifth grade.

We also showed evidence on the structural validity, external validity, and measure the reliability of the Interest in Reflective Thinking Scale. The evidence indicates that the Scale is an appropriate psycho-educational instrument for use in research on reflective thinking and people's interest in thinking reflectively.

Note that the Interest in Reflective Thinking Scale is open and free to use by all researchers who wish to do so. We hope that the Interest in Thinking Reflexively Scale will be a user-friendly tool and a new resource for researchers in the field.

CONFLICT OF INTEREST

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

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