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# Measuring media and information literacy skills: Construction of a test

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**Abstract:** Research on media and information literacy has been growing exponentially over the past years, but it has focused more on the examination of media practices than on the assessment of media and information literacy skills. In this paper we describe the process of designing and implementing a Media and Information Literacy Test comprising 20 items. We present the results of the analysis carried out to validate the items and to construct a scale of media and information literacy skills using Item Response Theory (IRT). Findings indicate that the conceptual framework adopted is adequate to measure media and information literacy and that the test has good discrimination and difficulty parameters. The test is based on a more comprehensive framework used to assess media and information literacy skills than those used in previous studies and can be used on an item-by-item basis. In this sense, it is a novel contribution to current efforts to measure media and information literacy skills.

**Keywords:** media and information literacy, direct assessment of media and information literacy skills, Item Response Theory

## 1 Introduction

Media literacy is believed to have a relevant impact on citizenship practices, as repeatedly conveyed by politicians and academics since the 1980s (Buckingham, 2003; Gonnet, 2001; Livingstone, 2011a, 2011b; Martinsson, 2009) and by international organizations such as UNESCO (1982, 1990, 1999, 2002, 2006,

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2007, 2008, 2009, 2011, 2012, 2013a, 2013b) the Council of Europe (2000, 2002, 2008) and the European Commission (2007a, 2007b, 2008a, 2008b, 2009a, 2009b). Importantly, it has the potential to increase the ability of citizens to interpret media messages critically and to communicate messages effectively (Zacchetti, 2011). The concept of “media literacy” itself was first defined by the Media Literacy Expert Group in 2006 as “the ability to access media, to understand and critically evaluate the different aspects of the media and media content and to create communications in a variety of contexts” (European Commission, 2007a). A few years later, UNESCO defined Media and Information Literacy (MIL) as “a set of competencies that empowers citizens to access, retrieve, understand, evaluate and use, to create as well as share information and media content in all formats, using various tools, in a critical, ethical and effective way, in order to participate and engage in personal, professional and societal activities” (2013b). As an evolving concept, “media” and “information” literacies have become integrated.

Today, citizens have access to a variety of media content and can place content online to communicate ideas, to react and to participate in discussions. New forms of communication, namely social media (like blogs, microblogging, internal wikis and collaborative software, social networks), have emerged and people need the skills to interpret what others say, to evaluate how publicity may influence choices and to select reliable information from search engines (European Commission, 2009a). Social inclusion in the information society is thus not only dependent on the ability of citizens to manipulate technology, but on their literacy skills (media, information, news, digital and many others). A media literate individual is one that communicates effectively and is able to create messages (Zacchetti, 2011). This ability to communicate effectively, in turn, will help ensure that individuals can exercise an active citizenship and contribute to democracy (European Commission, 2007b). Indeed, the Council of Europe (2008) has called for the identification and promotion of good media literacy practices exactly because they can increase the quality of information and contribute to a plurality of views.

While the construction and application of questionnaire surveys about media practices, such as type of media read and number of hours spent interacting with different media have already been developed (EAVI, 2011; Ofcom, 2012, 2013, 2016, for example), research on the direct assessment of media and information literacy skills is scarce. More specifically, the instruments designed to date have only provided insights on topic-specific media knowledge with restricted student populations. For example, Primack et al. (2006) developed a scale that measures smoking media literacy, Paul Mihailidis (2008) measured how media literacy can make students more engaged citizens, and Arke and

Primack (2009) designed an instrument that measures college students' ability to process media messages. In the latter study, only 34 students composed the sample, and they were all college students enrolled in a communication course. Moreover, their ability to create media messages was not tested. Similarly, the media literacy test developed by Ashley, Maksi and Craft (2013) measured news media literacy alone, and the participants were college students taking a news media course or a journalism course. In Portugal, studies on media and information literacy skills assessment started to be developed in the last decade (Lopes, Pereira, Moura and Carvalho, 2015). More recently, the work developed by the Iberian-American Alfamed network seeks to capture the media literacy competences of students and teachers from different educational levels [www.redalfamed.org]. In some countries such as Portugal, data is being collected during 2017 and countries' results are expected shortly thereafter. This paper describes the first research conducted in Portugal designed to measure media and information literacy using a direct assessment of competencies (Lopes, 2014), and so far the only one using Item Response Theory to analyze the results.

The media and information literacy test presented in this paper provides a new tool to assess media and information literacy beyond news consumption and encompasses a wider range of cognitive abilities. Moreover, this instrument is based on a broader framework of media and information literacy knowledge and skills that assesses respondents' ability to generate or create media messages. Also, the test has been applied to a large sample of adult students following secondary and tertiary education programs, and Item Response Theory was used to analyze the results. This procedure has the advantage of producing a scale composed of items that are calibrated according to difficulty levels and discrimination parameters that are independent of the tested population and the items used. These psychometric properties enable the development, evaluation and administration of a standardized measurement providing more accurate and consistent results.

Additionally, IRT allows the efficiency of the instrument to be checked, and new items can be inserted in the scale constructed to measure media and information literacy skills. Finally, the construction of a scale using IRT guarantees that the respondents are located on the same scale, allowing comparisons between respondents, between items and between respondents and items. As such, IRT is a reliable procedure for testing media and information literacy skills, and it will enable the establishment of relationships with other dimensions, such as media practices and citizenship practices.

This article describes the media and information literacy test and presents an analysis of the 20 items comprising it, as well as the methodology followed

to construct and validate the media and information literacy scale. We considered the overall proficiency level, and the analysis is carried out considering socio-demographic characteristics. The scales constructed enable a direct evaluation of media skills – citizens' ability to deal with media information, to interpret it and to act with it/on it.

## 2 The construction of the Media and Information Literacy Test

The Media and Information Literacy Test was conceptualized and developed on the basis of different conceptual and assessment frameworks (Lopes, 2015). First, test construction was informed by major extensive literacy studies, such as the International Adult Literacy Survey (IALS), the Adult Literacy and Life Skills Survey (ALL) and the Programme for the International Assessment of Adult Competencies (PIAAC) conducted by the Organisation for Economic Co-operation and Development (OECD, 2013). Second, the construction of the test was informed by research in the field of media and information literacy (Arke, 2005; Arke and Primark, 2009; EAVI, 2009, 2011; Hobbs and Frost, 2003; João and Menezes, 2008; Mihailidis, 2008; Quin and McMahon, 1991, 1995; UNESCO, 2011) and cognitive psychology (Morais, 2002, 2010; Rumelhart, 1977).

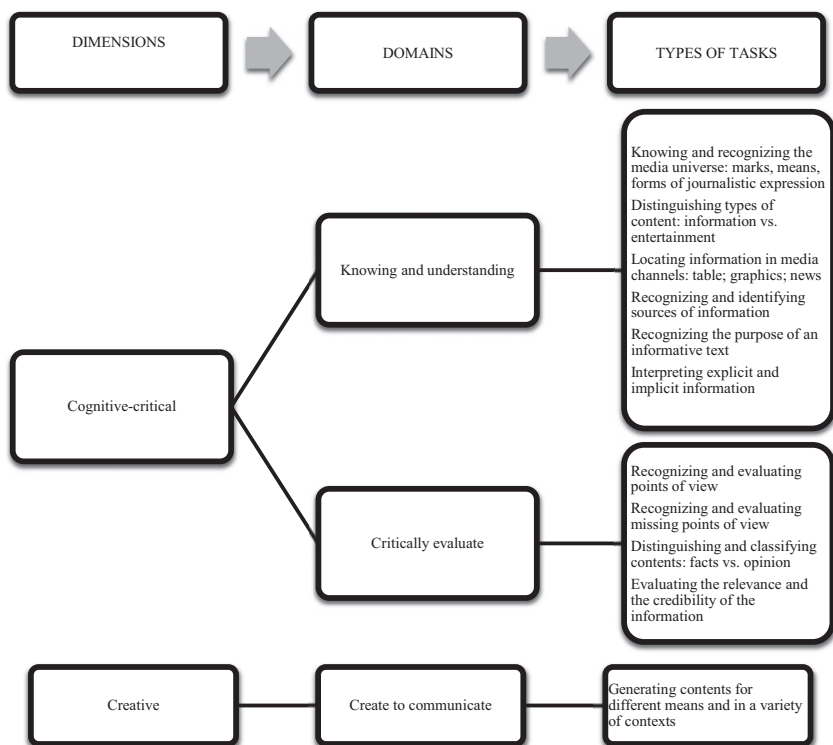
While the literature about media literacy and cognitive psychology was particularly useful in the operationalization of cognitive operations, the understanding of the journalistic text informed the construction of text items in terms of content selection and item design (Deacon, Fenton, and Bryman, 1999; Fairclough, 1995; Mathieu, 2009; Tuchman, 1978; van Dijk, 1983a, 1983b, 1988, 1990, 2002, 2008, 2009). Images and texts were selected according to the following criteria: They should be examples of those that readers are likely to encounter in a typical media environment and comply with the adopted assessment framework. That is, the items should include different formats (images, contiguous and non-contiguous texts), different types of media channels (informative, opinion) and call for different cognitive tasks. For example, the Apple logo (item example #1) was selected because several studies indicate that it is a highly visible image and a valuable brand in the media environment ([www.forbes.com](http://www.forbes.com)). In the case of the contiguous text that asks for the interpretation of media-related information (item example #2), the Journalist Code of Ethics calls for deductive reasoning as a cognitive task. With respect to the items that are opinion texts, these were published in the digital versions of the two most widely sold weekly newspapers in the country, *Expresso* and *SOL*. That was the case of item example #3 that discusses sexual discrimination.

The test was designed as a “printed booklet test”. Although we were aware that media and information literacy requires the ability to use technology to access information and to communicate, the administration of the test on a computer was not an option due to time constraints and lack of funding. The alternative was to select materials from different sources (printed and digital), which were the basis for the design of several tasks/questions posed to respondents using a paper-and-pencil test. These materials covered different item types and formats.



The construction of the tasks/questions was based on a conceptual model that included two major dimensions: cognitive and critical, and creative. The cognitive and critical dimension was oriented to evaluate whether respondents: a) identify and recognize media content; b) locate information; c) understand and interpret the purpose of a message; and d) critically evaluate information. The creative dimension was designed to evaluate the respondents’ skills concerning the generation of contents. These require the selection of information, the ability to mobilize background knowledge and the capacity to construct a media message, which in any media literacy test is a more time-consuming task. Still, we managed to include two media generation items, and our framework assumes that news literacy is an integral part of media literacy (Mihailidis, 2008). Thus, some items are representative of the journalistic genre by including information usually encountered in the media (Figure 1).

We followed the model of Kirsch, Jungeblut and Mosenthal (1998) applied in IALS and in ALL to define the structure variables and the process variables. The first set of variables refers to the different media channels, classified according to the format, the source means and the type of information. The second set refers to the process variables that capture the information-processing operations, or cognitive strategies, necessary to accomplish the tasks: locating and identifying, integrating and interpreting, evaluating and reflecting and generating (Figure 2). These cognitive strategies are similar to those currently considered in the assessment frameworks of different International Large-Scale Assessments (ILSA) of primary school students (e.g., The Program for International Reading Literacy Study – PIRLS) and of secondary school students (PISA) (Araújo, Morais, and Costa, 2013), as well as in surveys of adult skills, such as PIAAC (OECD, 2016). In all ILSA, the levels of difficulty validated using IRT models for the various items in the tests reflect increasingly demanding cognitive operations with the most complex tasks measured by a smaller number of items. Similarly, our test included fewer items requiring the generation of media content, a choice also motivated by the need to keep respondents engaged and avoid high non-response rates.

Our conceptual framework resulted in a matrix that guided the construction of the test and ensured that it would integrate media channels and tasks of a



**Figure 1:** Dimensions, domains and types of tasks.

Structure variables:	Process variables:
	
<b>Format of the media channel:</b> Continuous text Non-continuous text Image  <b>Source:</b> Printed Digital  <b>Type of information:</b> Textual informative Textual opinion Textual prescriptive Visual informative Visual opinion Visual instrumental	<b>Type of cognitive strategy:</b> (N1) Locating and identifying (N2) Integrating and interpreting (N3) Evaluating and reflecting (N4) Generating

**Figure 2:** Structure variables and process variables.

variety of types and degrees of difficulty. All the tasks (constructed response, open-ended and multiple-choice tasks) were classified according to the expected degree of difficulty in four levels. The most difficult tasks are those that result from the cross-checking of more complex cognitive operations and more complex media channels. For example, generating content is a more complex cognitive process than locating and identifying information. Similarly, texts are more complex than images. Thus, a task that combines generating content about a text is expected to be more difficult than one that requires identifying or naming an image. In summary, the test was operationalized as follows:

**Table 1:** Media and Information Literacy Test: Item classification.

DIMENSIONS	Domain	Cognitive Strategy	Items/Questions	Number of items (Percentage)
Cognitive-critical	Knowing and understanding	Locating and identifying	(1); (2); (3); (4); (5); (6); (7); (8); (17)	9 (45 %)
		Integrating and interpreting	(9); (10); (11)	3 (15 %)
	Critically evaluate	Evaluating and reflecting	(12); (13); (14); (15); (16); (19)	6 (30 %)
Creative	Create to communicate	Generating	(18); (20)	2 (10 %)

### 3 Examples of the test items

Below are some examples of media channels and respective tasks according to the expected levels of difficulty covered by the Media and Information Literacy Test.<sup>1</sup> For each example a summary table is also provided with item characteristics and item classification according to the conceptual model used to design the test.

<sup>1</sup> To ensure that test questions can be included and used as a bank of items, the whole instrument is not presented.

## Example 1: Level 1 task



*Identify the logo:*

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*Level 1 task example: Item characteristics and item classification*

- Item characteristics:  
 Format of the media channel: Image  
 Type of channel: Visual instrumental – Logo  
 Source means: Digital  
 Purpose: Recognizing and identifying a sign from the media universe: Brand
- Item classification:  
 Dimension: Cognitive-critical  
 Domain: Knowing and understanding  
 Cognitive strategy: Locating and identifying

## Example 2: Level 2 task

*Journalist Code of Ethics*

1. The journalist must report facts with rigor and accuracy and interpret them in a truthful way. The facts must be checked by consulting interested parties. The distinction between factual informational news and an opinion must be made clear to the reader.
2. The journalist must fight censorship and sensationalism and consider both accusations without proof and plagiarism as serious professional faults.
3. The journalist must fight against restrictions to access informational sources, attempts to limit freedom of expression and the right to inform.
4. The journalist must use legal means to obtain information, images or documents and refrain from abusing the good will of people. It is the rule of law to identify oneself as a journalist, and any deviation from this must be justified for reasons of public interest.
5. The journalist must assume responsibility for his or her work and professional conduct, as well as promote the rectification of information that has been proved inexact or false.

*After reading the “Journalist Code of Ethics”, indicate whether the following statement is true (T) or false (F):*

*“A journalist must work, simultaneously, as a public relations person.”*



*Level 2 task example: Item characteristics and item classification*

- Item characteristics:
  - Format of the media channel: Continuous text
  - Type of channel: Textual prescriptive: “Journalist Code of Ethics”
  - Source means: Printed
  - Purpose: Interpreting implicit information and inferring by deduction
- Item classification:
  - Dimension: Cognitive-critical
  - Domain: Knowing and understanding
  - Cognitive strategy: Integrating and interpreting

*Example 3: Level 3 task**Conquering is forbidden*

A priori, I have the same feelings for rapists as I have for murderers. That is, disgust and repulse, and I wish to see them in jail. This is in relation to the public protest of the Slutwalks. Let us trace the story. A ridiculous Canadian police officer went to the University of Toronto to defend the strange idea that the best way for women to avoid being raped was to stop dressing themselves as sluts.

This happened in January and since then emotions took over of helpless girls that protested in more than 70 cities worldwide. Dressed to kill, as nuns or cheaply-dressed, many held signs saying they have the right to present themselves as sluts, without this giving anyone the right to bother them. I couldn't agree more, provided that they are careful about the street corners they walk by. But let us go back to the actual sluts. They also say on the signs that they can dress as they wish and that they don't want to be bothered. That is, they don't want to hear compliments or experience any attempt of seduction. But has the world gone mad? How would the world be without seduction? We would click a button on the internet and desire would fire? I couldn't agree more that people should not bother each other. Yet, that they cannot show they like something is silly.

*Portuguese sluts on the street to protest*

Low-cut necklines, mini-skirts, laced tights, push-up pants, high heels (of course), provocative dresses: Next Saturday, Portuguese women will let their imagination loose (and their wardrobe too) to go out into the streets for their first “Slutwalk”.

They started in April and I must admit that I have been following with curiosity the proportions these “Slutwalks” against machismo have reached. The idea came from a group of Canadian women, after the statement of a police

officer who said that “women should avoid dressing provocatively if they don’t want to be raped”. The indignation of the high heels world spread like a fuse, and the Slutwalk reached over 70 cities, from Sidney to London and Brasilia. Could this be a sign that the silly comments of this police officer are, after all, common in these diverse countries? So it seems.

Yesterday I read the statement of the Portuguese walk and it made sense to me. I wrote this sentence here several times: Nothing justifies rape. And if we need to go to the street, barely dressed, in protest so that people understand this, then so be it. I make the street walk statement my own.

*After reading the texts from Vítor Rainho and Paula Cosme Pinto, answer the following question: “In your opinion, are there any references that may be considered discriminatory?” Justify your answer with some examples.*

*Level 3 task example: Item characteristics and item classification*

- Item characteristics:  
Format of the media channel: Continuous text  
Type of channel: Textual opinion  
Source means: Digital  
Purpose: Recognizing and evaluating the author’s point of view (the argument)
- Item classification:  
Dimension: Cognitive-critical  
Domain: Critically evaluate  
Cognitive strategy: Evaluating and reflecting

Example 4: Level 4 task

*Reading, mathematics and science results of 15-year-old students.*




**Table 1:** The rankings of the competencies assessment in PISA 2009 (reading, mathematics and sciences).

Reading	Mean	Mathematics	Mean	Science	Mean
South Korea	539	South Korea	546	Finland	554
Finland	536	Finland	541	Japan	539
Canada	524	Switzerland	534	South Korea	538
New Zealand	521	Japan	529	New Zealand	532
Japan	520	Canada	527	Canada	529
Australia	515	Netherlands	526	Estonia	528

Table 1 (continued)

Reading	Mean	Mathematics	Mean	Science	Mean
Netherlands	508	New Zealand	519	Australia	527
Belgium	506	Belgium	515	Netherlands	522
Norway	503	Australia	514	Germany	520
Estonia	501	Germany	513	Switzerland	517
Switzerland	501	Estonia	512	United Kingdom	514
Poland	500	Iceland	507	Slovenia	512
Iceland	500	Denmark	503	Poland	508
United States	500	Slovenia	501	Ireland	508
Sweden	497	Norway	498	Belgium	507
Germany	497	France	497	Hungary	503
Ireland	496	Slovakia	497	United States	502
France	496	Austria	496	Check Republic	500
Denmark	495	Poland	495	Norway	500
United Kingdom	494	Sweden	494	Denmark	499
Hungary	494	Check Republic	493	France	498
Portugal	489	United Kingdom	492	Iceland	496
Italy	486	Hungary	490	Sweden	495
Latvia	484	Luxembourg	489	Austria	494
Slovenia	483	United States	487	Latvia	494
Greece	483	Ireland	487	Portugal	493
Spain	481	Portugal	487	Lithuania	491
Check Republic	478	Spain	483	Slovakia	490
Slovakia	477	Italy	483	Italy	489
Israel	474	Latvia	482	Spain	488
Luxembourg	472	Lithuania	477	Luxembourg	484
Austria	470	Greece	466	Greece	470
Lithuania	468	Israel	447	Israel	455
Turkey	464	Turkey	445	Turkey	454
Chile	449	Bulgaria	428	Chile	447
Bulgaria	429	Romania	427	Bulgaria	439
Mexico	425	Chile	421	Romania	428
Romania	424	Mexico	419	Mexico	416

Source: PISA 2009

-  Statistically significantly above the OECD average.
-  Not statistically significantly different from the OECD average.
-  Statistically significantly below the OECD average.

*Write a news article, to be published in a major Portuguese daily newspaper (for example, the newspaper “Público”). Use the news lead basic structuring scheme (what happened, to whom, where, when, how and why).*

*Level 4 task example: Item characteristics and item classification*

- Item characteristics:
  - Format of the media channel: Non continuous (table)
  - Type of channel: Visual informative: Info graphic
  - Source means: Printed
  - Purpose: Selecting, organizing and generating information, taking into account the nature of the means (press)
- Item classification:
  - Dimension: Creative
  - Domain: Creating to communicate
  - Cognitive strategy: Generating/creating

## 4 Method

The implementation of the empirical research was based on a quantitative extensive methodology and involved the application of a questionnaire survey – for the examination of media practices and citizenship practices – and a Media and Information Literacy Test – for the evaluation of media and information literacy skills. In this article we describe only the construction and results of the Media and Information Literacy Test. The study was conducted using a quota sample of the adult population participating in different types of educational training, namely primary, secondary and higher education programs in the greater Lisbon area. The selection of students was proportional to the weight in the population of each type of educational program. For the students enrolled in higher education, the sample was proportional to the weight of the major scientific fields (arts and humanities, social sciences, natural sciences, engineering, health and social protection). Data was collected by the research team who visited the educational institutions where adults were in training and administered the questionnaire and the paper-and-pencil test individually without time limit.

The media literacy profile of the participants drawn from the media practices questionnaire revealed that the population sampled engaged in diverse media literacy practices. For example, while some adults read newspapers every day, other rarely did so. Thus, the heterogeneity of the sample in terms of age, educational level and literacy profiles is characteristic of the adults in the great-

er Lisbon area. This in conjunction with the use of IRT methodology makes it possible to validate test items and to gain an understanding of the media literacy skills of adults.

## 4.1 Participants

The sample was comprised of about 500 adults attending some level of education (primary, secondary, higher) during the school year of 2011–2012 in the Greater Lisbon area. In our sample, 9.8 % of the respondents attended primary education, 15.6 % attended secondary education and 74.6 % attended different higher education courses and pursued different degrees. The respondents attending primary and secondary education were adults completing continuing education certification programs. The university level students came from different institutions of higher education in Lisbon. At the time of the test, the ages of the respondents varied between 18 and 81, with an average age of 27 years old. There was a slight female dominance in this sample: 57.9 % of the respondents were women.

## 4.2 Procedure

We used Item Response Theory (IRT) for the purpose of constructing a scale that reflects the respondents' skills in Media and Information Literacy. IRT is used to estimate the proficiency level of a respondent and to produce precise information about each test item. With IRT it is possible to represent the relation between the probability of an examinee to respond correctly to an item and its latent factor in the field of knowledge to be evaluated. Thus, the relation established is expressed in such a way that the higher the latent factor, the higher the probability to answer correctly to the item. The relation between the performance in the item and the latent factor is described through an increasingly monotone function named Item Characteristic Curve (ICC).

We analyze the Media and Information Literacy Test data using IRT modeling and specifically using the Generalized Partial Credit Model – GPCM (Muraki, 1992, 1997), which is theoretically adequate for polytomous items and in which the discrimination ( $\hat{\alpha}$ ) and difficulty ( $\hat{\beta}$ ) parameters are considered factors that influence the choice of answers and characterize respondents. The discrimination parameter tells us how effectively an item can discriminate between highly proficient respondents and less-proficient respondents. Lower values for the difficulty parameter are associated with easier items. The GPCM indicates that the probability of a student responding to the answer category  $k$

is given as the conditional probability on categories  $k-1$  and  $k$ , that is, it states the points in the latent factor scale where an answer becomes relatively more probable than the preceding one, in view of the fact that the respondent has completed the previous steps.

The item parameter and latent factor estimates, the performance (ability) in media and information literacy, are obtained through the application of the Marginal Maximum Likelihood (MML) estimation procedure using the EM algorithm (Baker and Kim, 2004). Estimation using this procedure is performed using the Parscale software (Muraki and Bock, 2002). In the analysis of the test items using IRT, we present the estimates of the discrimination and difficulty parameters. In order to validate the methodology, we also evaluated the adequacy of the theoretical model for the empirical data, the information function of the test<sup>2</sup> – IFT – (Muraki, 1993) and the measurement error.

## 5 Results

In order to construct the media and information literacy scale, first the psychometric properties of the items are presented followed by the presentation of the features of the overall scale. Performing this two-step statistical analysis guarantees the reliable measurement of media and information literacy skills because the overall scale is composed of items of good quality.

### 5.1 Item parameters

Descriptive statistics of the item parameter estimates – discrimination and difficulty – are shown in Table 2. Items 4, 5, 12, 13, 14, 15 and 20 have three answer categories (correct/partially correct and incorrect), while the remaining test items are dichotomous (correct/incorrect). The descriptive statistics of the item parameter estimates calculated using IRT show that the distribution of the item discrimination parameter estimate is asymmetric, the mean is equal to 0.752, the median is equal to 0.730, and skewness is equal to 0.220. Regarding the difficulty parameter, the distribution's mean is equal to  $-0.382$ , the median is equal to  $-0.291$  and has a negative skew (skewness =  $-0.215$ ). Therefore, the distribution is asymmetric with a long tail to the left. These findings indicate that the 20 test items are mostly easy and of medium difficulty.

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<sup>2</sup> IFT is used to assess the performance levels where each of the tests is more or less discriminative.

**Table 2:** Descriptive statistics of the item parameter estimates.

	$\hat{\alpha}$	$\hat{\beta}$
<i>N</i>	20	20
Mean	0.752	-0.382
Median	0.730	-0.291
Standard deviation	0.159	1.166
Skewness	0.220	-0.215
Minimum	0.489	-2.383
Maximum	1.080	1.535
Percentiles		
25	0.634	-1.524
75	0.866	0.543

**Table 3:** Item parameter estimates.

Item	$\hat{\alpha}$	$\hat{\beta}$
1	0.940	-1.908
2	0.489	0.215
3	0.668	-1.676
4	0.723	-2.383
5	0.809	-2.309
6	0.963	-0.773
7	0.882	-0.778
8	0.625	0.291
9	0.736	-1.520
10	0.593	-0.418
11	0.790	-1.534
12	0.507	1.535
13	0.570	0.161
14	0.953	1.024
15	0.828	0.633
16	0.861	-0.164
17	1.080	-0.558
18	0.654	0.869
19	0.724	0.514
20	0.637	1.131

The GPCM model estimates rendered the item parameter estimates shown in Table 3.

The items with the highest discrimination parameters are items 1, 5, 6, 7, 14, 15, 16 and 17, while the less discriminative are items 2, 10, 12 and 13, even though the latter have acceptable discrimination parameters. Regarding the

**Table 4:** Classification of the test items in terms of discrimination and difficulty parameters.

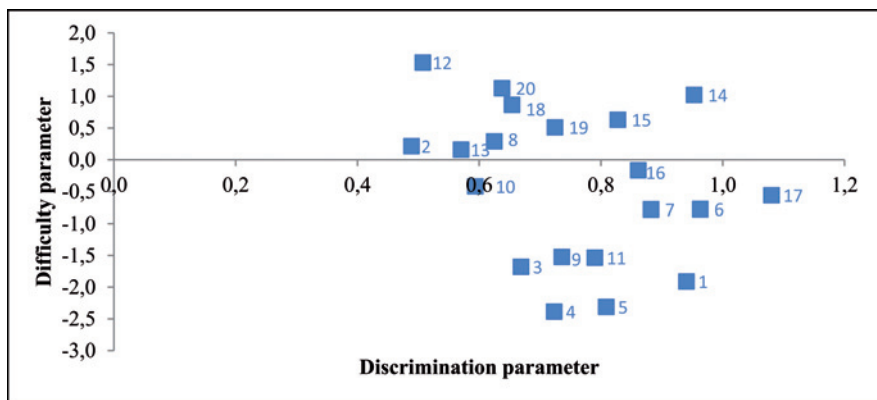
Items classification			
Discrimination	Limits	Items	Number of items
Little discriminative	$< 0.4$	–	0
Discriminative	$[0.4; 1[$	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20	19
Very discriminative	$\geq 1$	17	1
Difficulty	Limits	Items	Number of items
Easy	$[-3; -1[$	1, 3, 4, 5, 9, 11	6
Medium	$[-1; 1[$	2, 6, 7, 8, 10, 13, 15, 16, 17, 18, 19	11
Difficult	$[1; 3]$	12, 14, 20	3

difficulty parameter estimates, larger  $\hat{\beta}$ -values represent more difficult items. Thus, the most difficult items are items 12, 14 and 20, while the easiest are items 4 and 5.

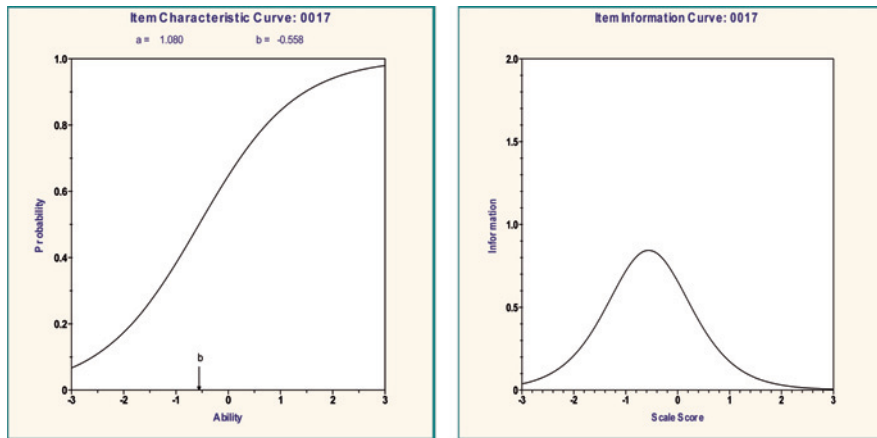
Table 4 presents the item classification according to the estimates of the discrimination and difficulty parameters.

The graphic representation of the items' dispersion, according to the discrimination and difficulty parameters, is shown in Figure 3.

These analyses indicate that almost all items are discriminative and that the discriminative items fall into all levels of difficulty. From the 19 items of medium discrimination, six items are easy (1, 3, 4, 5, 9 and 11), ten items are of medium difficulty (2, 6, 7, 8, 10, 13, 15, 16, 18 and 19) and three items are

**Figure 3:** Dispersion of the test items, discrimination parameter by difficulty parameter.





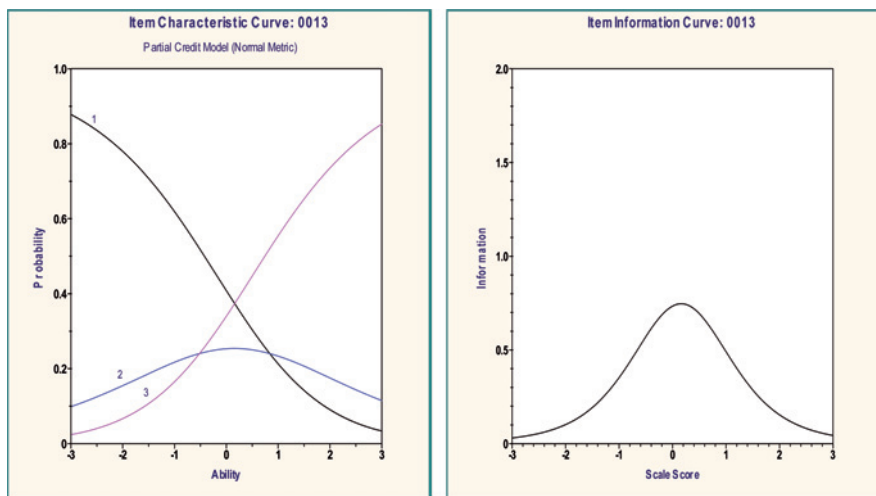
**Figure 4:** Item 17 characteristic curve and information function – 2 categories.

difficult (12, 14, 20). Item 17, which is very discriminative, is of medium difficulty.

Comparing the difficulty item parameters with item classification, 30 % of the items are easy, and all of them are from the “Knowing and Understanding” area of analysis. Of these, 20 % measure tasks related with “Locating and Identifying”, and 10 % assess tasks related with “Integrating and Interpreting”. Additionally, 15 % of the items are difficult, and they were classified in the areas of “Critically Evaluate” and “Create to Communicate” (10 % and 5 %, respectively). Next, as an example we present the characteristic curve and the information function for two of the test items with two and three answer categories, respectively.

Item 17 (Figure 4) is dichotomous and was answered correctly by 67.2 % of the respondents. It can thus be considered an item of medium difficulty, which is confirmed by the difficulty parameter estimate, and by the observation of the horizontal axis of the item characteristic curve. The ICC of this item is “S”-shaped with a good power of discrimination between different levels of ability, which is corroborated by its estimate. It is an item of medium difficulty, and the slope of the ICC shows that the item presents a good discrimination among respondents with ability around  $-0.5$ . The item information function shows a strong contribution of item 17 for the information function of the test, namely for respondents with low and medium performance.

Item 13 (Figure 5) has three answer categories, and 38.9 % of the respondents answered the question correctly, 44.9 % gave an incorrect answer and 16.2 % obtained a partially correct item score. Therefore, and considering also



**Figure 5:** Item 13 characteristic curve and information function – 3 categories.

the difficulty parameter estimate, the item is of medium difficulty. Regarding the discrimination parameter estimate, this item is discriminative.

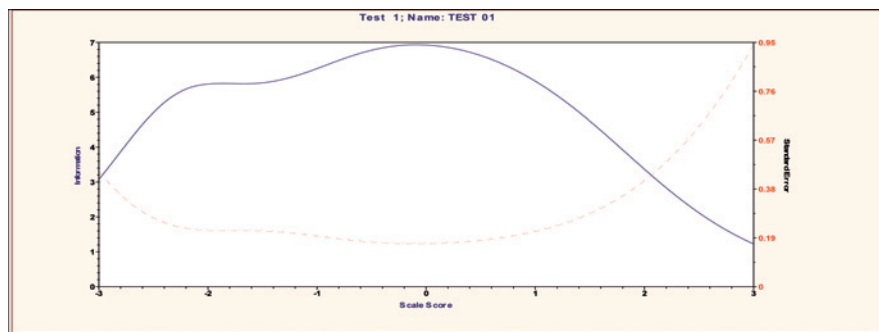
This item's characteristic curve is composed of three curves referring to the item answer categories. As the figure shows, answer category 1 has higher probability for lower performance levels, category 2 demonstrates higher probability for intermediate performance levels, although inferior to the other categories, and that category 3 demonstrates higher probability for higher performance levels. Thus, the information function reflects a good contribution to the test, particularly for respondents presenting low and medium scores in the media and information literacy scale.

The analysis of the GPMC model adjustment to the data, based on the statistics of the chi-square test, shows that only items 4, 15 and 16 do not adjust to the model and that all the remaining are adjusted to the proposed model (Table 5).

The information function of the test (Figure 6) contributes with a larger amount of information mainly regarding respondents presenting a performance between  $-1$  and  $1$ . Since there is an increase in the measurement error for performance levels higher than  $2$ , this suggests that this test contributes less discriminating respondents with a high performance level.

**Table 5:** Statistics of adjustment to the model.

Item	Chi-square	D.f.	Prob.
1	2.384	3	0.5
2	18.227	15	0.25
3	4.677	8	0.793
4	5.978	2	0.049
5	0.511	1	0.482
6	18.821	11	0.064
7	16.604	12	0.165
8	11.582	15	0.711
9	15.528	9	0.077
10	12.889	14	0.536
11	11.496	7	0.118
12	24.545	21	0.267
13	19.831	22	0.594
14	25.174	23	0.341
15	46.805	23	0.002
16	35.156	13	0.001
17	10.331	12	0.588
18	23.303	15	0.078
19	15.550	15	0.413
20	35.168	23	0.05

**Figure 6:** Information function of the test and standard error of the test.

## 6 Media and information literacy scale

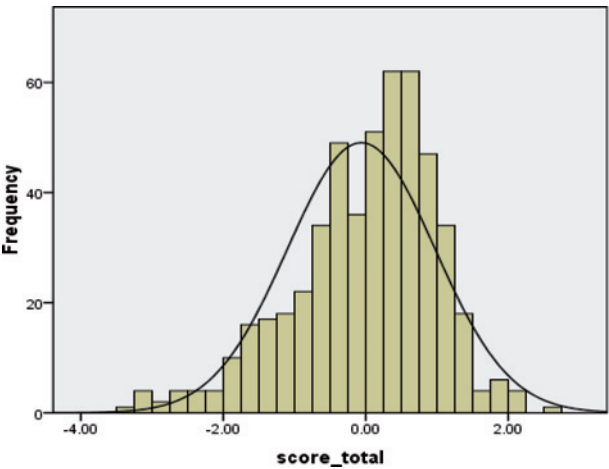
Table 6 presents the descriptive statistics of the respondents' scores/ability in media and information literacy, estimated using IRT from the answers to the 20 items of the test.

**Table 6:** Descriptive statistics of the respondents' scores distribution.

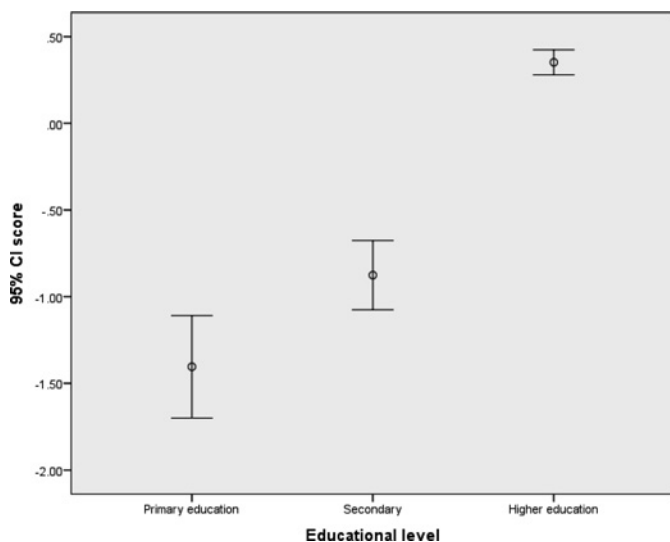
Scores in media literacy		
<i>N</i>	Valid	510
	Missing	2
Mean		.0000
Median		.1804
Standard deviation		1.00098
Skewness		-.697
Standard error of skewness		.108
Amplitude		5.92
Minimum		-3.25
Maximum		2.66
Percentiles	25	-.5486
	75	.6966

The distribution of the estimate of the students' performance in media and information literacy, resulting from the GPCM model, is presented in the histogram below.

The previous table and figure show that the respondents' scores in the test vary between  $-3.25$  and  $2.66$ . The distribution of the respondents' scores is asymmetrical with a long tail to the left (skewness =  $-0.697$  and standard error =  $0.108$ ). The mean of the respondents' scores is zero, and the median is equal to  $0.18$ .



**Figure 7:** Histogram of the respondents' scores in the test.



**Figure 8:** Error bars representing the 95 % confidence interval by educational level.

With respect to the differences in adults' scores by socio-demographic characteristics, statistically significant differences were not observed between males and females ( $t = -1.372$  with  $p > 0.05$ ). For the comparison of the respondents' scores by educational level (primary, secondary and higher education) statistically significant differences were found among all the educational levels, as the error bars below show. The mean for the lowest educational level was  $-1.40$ ,  $-0.88$  for the intermedium level and  $0.35$  for the highest educational level. As expected, adults with a higher educational level perform better in media and information literacy.

## 7 Discussion and conclusions

We designed a media and information literacy test and analyzed it using IRT to measure the ability of respondents to deal with media information, to interpret it and to act with it/on it. The results indicate that almost all items are discriminative or very discriminative and fall into all levels of difficulty (difficult, medium and easy), with a special incidence at the medium level. The analysis of the adjustment of the model to the data (chi-squared test) indicates that items present a good fit to the model, with the exception of three of the twenty items. Additionally, results indicate that the test contributes with a larg-

er amount of information regarding respondents with low and medium performance levels. That is, it contributes less to discriminate among respondents with a high performance level. Thus, this media and information literacy test is a methodologically appropriate tool that assesses empirically the underlying literacy skills' theoretical framework. As such, it constitutes a valid instrument to measure adults' ability to respond to and create media and information literacy content. Future efforts should address the need to design more items that pertain to creating media content. It is possible that if the test had included more difficult items with good discrimination parameters, it would have contributed more to discriminate respondents with a high performance level.

According to the conceptual framework, the three difficult items (#12, 14 and 20) reflect higher-order cognitive operations: the ability to critically evaluate content and the ability to generate content (see Table 1). Thus, they required the respondents to act on the information. In this sense, the empirically tested information about these items is in accord with what was expected given the underlying conceptual framework. Tasks that require higher levels of information processing are more difficult, and items that call for identifying and integrating information are easier. As the examples of test items show, item 1 was defined as level 1, item 10 as level 2, and item 15 as level 3. The IRT analysis confirmed that the first is easy and the other two are of medium difficulty. That is, locating and identifying information (item 1) is easier than integrating and interpreting information (item 10) and this, in turn, is easier than evaluating content (item 15).

Considering the media and information literacy skills by gender, the findings show that no statistically significant differences were found between males and females. These results are partially in line with the findings from PIAAC (OECD, 2013), which showed that in half the countries surveyed, the differences on the literacy scale by gender are not statistically significant. However, it should be noted that PIAAC does not measure media and information literacy skills, and that so far Portugal did not participate in this survey. Conversely, we found a positive association between educational level and the respondents' media and information literacy scores, and these results are consistent with findings from PIAAC. In this survey, as expected, people with lower levels of education also present lower literacy skill levels in all participating countries (OECD, 2013).

In this study, the application of IRT enabled the analysis of the test items, thus contributing to a better understanding of the respondents' performance when submitted to this type of instrument. More specifically, the use of IRT to assess media and information literacy skills enabled the validation of the test items, highlighting the importance of the application of this statistical proce-

dures for the evaluation of the skills of respondents of different educational and age levels, as well as of adults in general. Importantly, because we used IRT, the test can be used on an item-by-item basis or as a bank of items for the assessment of media and information literacy skills. If these items are applied to other respondents, the estimates of the item parameters will be invariant.

Given that the respondents' scores are estimated according to the characteristics of the items – difficulty and discrimination – this ensures that the respondents with the highest media literacy proficiency answered correctly the most difficult items. Thus, the use of IRT guarantees that an item level analysis of media literacy is measured properly. Using classical test theory, it would not have been possible to have information at the item level or to take into consideration item characteristics in the respondents' scores. As such, IRT facilitates the interpretation of the scale produced and enables the comparison of the results from different groups of individuals, even when partially different tests are applied. The use of IRT also makes it possible to assess the evolution of a measurement across time, in this case the measurement of media and information literacy skills.

In short, this study makes some notable contributions to the field of media and information literacy. The aim of this project was to construct a media and information literacy test informed by assessment frameworks used in other large-scale studies. Findings show that it is possible to design good quality test items using the conceptual framework we adopted. Results also show that the test discriminates well among people with low and medium proficiency levels, but less well among people with higher ability levels. In this sense, if the aim is to capture the skill level of high-ability adults, it is desirable to design items that can discriminate among subjects at higher ability levels. Future research should address this issue and also try to incorporate tasks that assess digital media abilities. Our instrument included an item that called for writing a tweet, but did not test the ability to actually post it. However, research indicates that digital skills and competences can be intertwined with literacy skills. For example, in the 2012 digital PISA round, the higher the quality of internet navigation (e.g., number of clicks to relevant links), the higher students scored in reading, even after controlling for their print reading skills (OECD, 2015). A policy relevant message from this finding is that, as Hatlevik, Guðmundsdóttir and Loi (2015) highlight, the development of digital competences implies strategic use of information. In this sense, educational policies that encompass teaching digital skills from an early age should be encouraged so that the citizens of tomorrow can critically interpret and create media messages.

In conclusion, the construction and analysis of the Media and Information Literacy Test, an instrument for the assessment of media and information litera-

cy skills, resulted in the creation of an “item bank” with information on the specific characteristics of each item. This bank – composed of a set of calibrated, discriminative items with different levels of difficulty – enables the assessment of media and information literacy skills and can be used in different tests and/or moments. In this sense, the construction and application of this instrument is a significant methodological contribution to the assessment of media and information literacy knowledge. Therefore, this work provides a scientifically robust and methodologically valuable contribution to the research on media and information literacy skills.

**Disclaimer:** The views expressed are purely those of the writers and may not in any circumstances be regarded as stating an official position of the European Commission.

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