Fundaments of Critical Thinking Evaluation in High Education

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Abstract

Critical Thinking is a highly relevant topic for education, especially in higher education, considering its role in professional training and knowledge production. The concept of critical thinking is associated with a reasoning that holds more complexityand superior quality and supports informed decision making, leading to more effectiveproblem solving. Several instruments have been produced and validated for this purpose and have different characteristics: question format; main skills assessed; type of problem presented; application format. These differences do not constitute oppositions, since the different abilities can be grouped into three great groups: argument analysis; explanation and decision making/problem solving. The understanding of critical thinking in three fundamental stages, which encompass the complexity of thinking and the essential points in this process, establishes more specific parameters of monitoring and evaluation. Faced with the complexity of aspects and processes involving critical thinking, the search for structuring fundamental stages is not an easy task and is not intended to reduce or simplify the concept,but it is expected that with this structuring skills, it will be possible to develop intervention programs and evaluation instruments that are increasingly effective.

Keywords: Critical thinking, higher education, transversal skills, evaluation

1. Critical thinking and its role in higher education

The definition of critical thinking, although it does not find consensus in the scientific community (Amorim, 2013; Brady, 2008; Dias, Franco, Almeida, & Joly, 2011; Halpern, 2002), is associated with a reasoning of complexity and superior *status* (Brady, 2008; Dias et al., 2011). Superior cognitive functions are understood as specific mental functions that include complex behavior that includes analysis and synthesis, substantiation, and decision-making in a goal driven perspective (Pereira & Alich, 2015). Halpern (2002) defines critical thinking as the use of cognitive skills or strategies that increase the likelihood of a desirable outcome and has the characteristic of being intentional, substantiated and goal-oriented. Pereira e Alich (2015) add the characteristic of information selection that must guide the beliefs and actions, where the idea of evaluation, decision making and opinion building is implicit. In an attempt to summarize Critical Thinking, Rivas e Saiz (2010) define as a process of seeking knowledge through thinking skills, problem solving and decision making which increases the results effectiveness. This way of thinking involves different dimensions or functions: articulation of ideas; elicitation of meaning; consideration of divergent arguments and search for evidence to evaluate each legitimacy; hypothesis formulation; justification of own arguments, beliefs and activity; decision making; troubleshooting; and, additionally, monitoring and evaluation of one's own cognition and actions (Almeida & Franco, 2011; Butler et al., 2012; Halpern, 2002; Jorge, 2012; Pereira & Alich, 2015).

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These mechanisms have direct correlation with the objectives of Higher Education (HE) and reinforce the view of critical thinking as the main objective to be reached in this stage of schooling (Almeida & Franco, 2011; Amorim, 2013; Butler et al., 2012; Dias et al., 2011; Esteves, 2008; Ku, 2009; Pereira &Alich, 2015; Saiz& Rivas, 2008; Veiga, Cardoso, Costa, & Jácomo, 2016; Zimmerman, 2002). Education has as a function the development of the capacity to constantly learn throughout life (Zimmerman, 2002) and in ES, the role in the development of critical thinking is highlighted (Veiga et al., 2016) as a need of university students (Joly, Dias, Almeida, & Franco, 2012). In addition, Critical thinking, in this way, provides a basis for appropriate decision-making and lifelong learning. Franco e Almeida (2017) summarize this conception by conceiving critical thinking "... as one of the nuclear missions of this level of education" (p. 121). An operative description of critical thinking, self-regulation and metacognition are important points that should be highlighted. Davis e Nunes (2016) point that self-regulation and metacognition are extremely important skills that are seldom taught in school, stating that by failing to teach students how to engage in their own learning and learn more and better, the school risks being innocuous The concept of metacognition, according to Flavell (2004), refers to knowledge or cognitive activity directed to own cognition. Metacognition refers to knowledge about what we know, knowledge itself, what we think, what we remember, and the use of this knowledge to acquire new learning (Favieri, 2013; Halpern, 2002). Tébar (2011) specifies the definition of metacognition as "the knowledge, supervision and control that the subject exercises over his own thought processes. It involves knowledge of cognitive functioning and activities linked to the control of cognitive, affective and motivational processes "(p.542); It concerns the process of learning, acquiring, controlling, storing, retrieving and employing knowledge leading to awareness, criticism and self-regulation in decision-making. In turn, self-regulation is understood as the ability to self-generate thoughts, feelings and actions in a way that allows the cyclical re-evaluation of the processes aiming at reaching the goals (Simão & Frison, 2013; Zimmerman, 2002). To Zimmerman (2000), learning is seen as a proactive phenomenon, so that students who are successful know their strengths and limitations and are guided by goals. One may add that when we focus on the context of HE and the preparation of professionals who will act in the world and with people making decisions and solving problems, the effectiveness of their actions, the expertise and the potential to follow the advances of knowledge, constantly learning, are indispensable characteristics that must be developed and understand the scope of the skills of the critical thinker. (Amorim, 2013). Critical thinking also implies behavioral application of cognitive skills (Dias et al., 2011; Silvia Fernandez Rivas & Saiz, 2010). According to Tébar (2011, p. 79), "behavior is a cognitive-affective act." In addition to possessing the necessary skills to make the right choices, the subject should wish to do so, that is, it refers to a sensible action involving the cognitive and emotional spheres (Veiga et al., 2016).

However, saying that critical thinking embraces affective and cognitive aspects does not mean understanding it as "having an opinion" or "defending your point of view"(Halpern, 2002). Critical thinking is about basing your decisions on arguments and data, it means making informed decisions; reasoning is the core of thinking whereas problem solving involves a lot of intellectual activity (Saiz & Rivas, 2008).

2. Evaluation of critical thinking

Considering the concept of critical thinking, one can already infer the difficulty involved when evaluating its evaluation; however, its importance in the educational and professional setting justifies efforts to establish evaluative standards and the creation of reliable instruments for this purpose. The evaluation of critical thinking allows understanding the reasons and connections that the subjects elaborate to decide or to act (Pereira & Alich, 2015). Several authors (Ennis, 1993; Ku, 2009)emphasize the importance of a valid evaluation to subsidize improvements in learning processes, both for the students themselves and for teachers and institutions. Considering that the evaluation should be consistent with the concept of what is intended to be evaluated, the evaluation of critical thinking should not avoid considering the cognitive and motivational character of behaviors and processes involved (Ennis, 1993; Ku, 2009). Rivas and Saiz(2010)point out that, in critical thinking evaluation, the most common difficulties concern conceptual and methodological aspects, first referring to the need to adopt a valid conceptualization and, secondly, to use an adequate method to obtain the wanted answers. There are different instruments that aim to evaluate critical thinking, varying in their purposes, formats and contexts (Ku, 2009).

According to com Ku (2009), the most known existing instrument to evaluate criticsal thinking are: Watson-Glaser Critical Thinking Appraisal (Watson & Glaser, 1980); Ennis-Weir Critical Thinking Essay Test (Ennis & Weir, 1985); Cornell Critical Thinking Test (Ennis, Millman, & Tomko, 1985); California Critical Thinking Skills Test (Facione, 1990) and Halpern Critical Thinking Assessment Using Everyday Situations (Halpern, 2007). Considering our own research in the area, we can also add the test of critical thinking PENCRISAL(Rivas & Saiz, 2012).

The *Watson-Glaser Critical Thinking Appraisal (CTAI)*contains 80 multiple choice questions aimed to assess five categories: inference, recognition of assumptions, deduction, interpretation and argument evaluation (Álvarez & Yair, 2013; Sousa, 2015). The revised version, The Watson-Glaser II Critical Thinking Appraisal (Watson & Glaser, 2009), includes the possibility of applying a reduced questionnaire containing 40 items. The issues involve two types of scenarios: neutral or controversial; being the neutral ones that approach contents free of strong feelings or prejudices, like climate or common situations; And controversial ones concern issues that elicit emotional responses, such as social or political issues, for example(Watson & Glaser, 2009).

Using the open - response model, the *Ennis-Weir Critical Thinking Essay Test*is addressed to university students and calls for the person draw up an argument over a given situation. The skills evaluated are: to incorporate the point of view; explain the reasons; hypotheses and premises; offer good reasons; recognition of other possibilities; to present responses avoiding ambiguities and irrelevance and the emotive use of language to persuade (Álvarez & Yair, 2013). It is organized in two levels - X and Z - the first being directed to children and youth 9-18 years. In the scope of this work, it is interesting to approach Level Z, aimed at university students and adults, and it can also be applied in advanced students of basic and average education, consisting of 52 multiple choice questions with three alternative answers that aims to evaluate: induction ; Credibility of a source; semantics; Prediction and experimentation; fallacy; deduction; Definition and identification of hypotheses(Álvarez & Yair, 2013; Silvia F. Rivas & Saiz, 2012).

Aimed at executives, postgraduate and graduation university students, the *California Critical Thinking Skills* Test aims to assess: interpretation; analysis; evaluation; explanation and inference (Álvarez & Yair, 2013). It consists of 34 multiple choice items with an average execution time of 45 minutes(Facione, 1991). Considering motivational and behavioral aspects of critical thinking, *Halpern Critical Thinking Assessment Using Everyday Situations (HTCA)* uses everyday situations where multiple choice questions and open answers (Sousa, 2015). The instrument considers five categories understood as capable of responding to what students should know and be able to do when entering the labor market (Halpern, 2010), such as: verbal reasoning; Argument analysis; Proof of hypotheses; Probability and uncertainty, and decision making and problem solving. The HTCA consists of 25 scenarios, five of each category, in which respondents must first answer open questions and then multiple choice questions. Despite being structured with the same number of scenarios for each competency evaluated, the assigned value is differentiated, so that problem solving has a greater weight (31%), followed by verbal reasoning (24%), proving hypotheses (21 %) And analysis of argument and probability and uncertainty (12%, each), staggered considering its importance and contribution to critical thinking.

At last, the PENCRISAL – Critical thinking, Salamanca(Saiz & Rivas, 2008; Rivas & Saiz, 2012)consists of 35 situations in open-ended questions, to be answered in colloquial language and presenting justification for the answer, without time is between 60 and 90 minutes. The test can be carried out on paper or in an electronic media and aims to evaluate five aspects: deductive, inductive and practical reasoning, decision making and problem solving
.

3. Fundamental criteria for critical thinking evaluation in higher education

The various tests that aim to evaluate critical thinking indicate the competencies considered fundamental for critical thinking to be effective. The way in which these competences are approached is not uniform and does not find consensus in these tests, however some convergence between them and the previously discussed concepts are perceived. The analysis of the dimensions evaluated by the critical thinking tests can be understood in three main stages: argument analysis; explanation or rationale of principles or data; and decision making / problem solving. Considering critical thinking as the process of searching for knowledge that allows for informed decisions that increase the likelihood of the expected result (Saiz & Rivas, 2017; Saiz, 2017), thinking critically implies understanding the problem, seeking solutions to the problem, and Know how to choose the most effective solution, adding a motivation and attitude of deliberate permanence in the effective resolution of situations. Table 1 lists the critical thinking tests bystage group and dimensions of each defined stage.

Table 1 Division of competences of some critical thinking tests per stage

	Argument analysis	Explanation	Decision making and problem solving
CTAI	Evaluate arguments; recognize assumptions	Inferences; Deduction; Indiction	
Ennis-Weir	Incorporate viewpoin;	Explaining reasons; Hypotheses and premises; avoid ambuguities and irrelevance; Good reasons; Other possibilities.	
CCTST	Source credibility; Semantics; Fallacy.	Induction; Deduction; Prediction and experimentation; Definition and identification of hypotheses.	
California	Interpretation; Analysis	Inference; Explanation; Evaluation	
HTCA	Verbal reasoning; Argument analysis.	Hypotheses testing; Probability and uncertainty.	Decision making and problem solving
PENCRISAL		Deductive reasoning; Inductive reasoning; Practical reasoning.	Decision making and problem solving

Describing these more evident steps and abilities, the analysis of arguments concerns the understanding of the problem to be solved, is related to the ability to correctly interpret the aspects that compose it and to analyze the relevance or irrelevance of the known data. Skills related to of argument evaluation or analysis, acknowledgments of assumptions, source credibility source, verbal reasoning, among others, evaluated in different critical thinking tests, evoke the ability to define the problem and its dimensions and data collection needed to search possible solutions. In turn, the explanation or rationale is configured as the quest to understand the causes and consequences of the problem. It is from this understanding that it is possible to propose hypotheses of explanation and solution. All the instruments of evaluation of critical thinking cited consider such competences in evaluation, which can be observed mainly in inferential, deductive and inductive thinking, as well as in the dimensions described as definition and identification of hypotheses, probability and uncertainty, among others. Finally, after an effective understanding of the problem and the possibility of resolution,it is necessary to take the decision which would result in an expected, efficient and favorable outcome. The evaluative difficulty in this aspect is evident, considering, mainly, that this decision is not defined exclusively by the competences, but mainly by the dispositions (Franco & Almeida, 2017). Given this difficulty, specific decision-making and problem-solving skills are not explicitly included in all of the above tests.

4. Conclusions

Higher education aims to train professionals capable of acting in reality, using specific knowledge of their area of action to solve problems and make decisions that, in most cases, will have an impact on individuals, groups or society as a whole. Moreover, considering the celerity and volume of today´s knowledge production and dissemination, more important than acquiring concepts is to be able to learn constantly, considering that learning is not limited to access to information, but the proper interpretation of such data, as well as the ability to assess, criticize and use such knowledge when appropriate. Teaching at this stage, often focused on theoretical knowledge and the memorization of concepts, has the challenge of proposing training processes that guarantee the integral development of students in order to meet the individual, professional and labor market demands. In this way, higher academic education is not confined to the acquisition or development of technical and scientific competences. The complexity and constant change of social life and a commitment to ongoing training throughout the life cycle of individuals calls for ES which also develops a wide range of soft skills. The development of critical thinking, understood as a reasoning of quality and superior requirement, integrating cognitive and attitudinal or motivational elements, stands out because of its comprehensiveness. In this context, the evaluation of critical thinking becomes indispensable to follow this process development, providing subsidies on the main competence to be developed in the HE. The volume of scientific publications critical thinking evaluation reaffirms the theme´s complexity and importance, since different instruments have been produced and validated for this purpose. Many authors emphasize that critical thinking is essentially associated with specific cognitive abilities.

The analysis of the most used tests indicates three fundamental steps that must be considered in the process of understanding the capacity to think critically: argument analysis; explanation or rationale of principles or data; and decision making / problem solving. In addition to these cognitive abilities, it is important to consider that the literature emphasizes that critical thinking requires motivation and an attitude of perseverance on the part of individuals in their implementation.

Also because of this plural nature of the intervening variables, critical thinking is difficult to operationalize and evaluate, but its relevance fully justifies the efforts made to construct new instruments that expedite its evaluation, also ensuring the properties of accuracy and validity of collected data.

Various instruments are now available for higher education students, yet none of them sufficiently developed in Portuguese-speaking countries. In this sense, this article synthesizes information to be counted in the construction and subsequent validation o f a new test for the evaluation of critical thinking in late adolescence or in young adults. Based on this synthesis, this evidence should include the understanding and production of arguments, explanation and reasoning of situations, and decision making and problem solving. The option will be for situations reported to the daily life of the individuals under evaluation, and with a heterogeneous response format valuing some elaboration and not the simple multiple choice response. In the end, it is expected that, with this test, we will be able to investigate how HE develops critical thinking of its students. At that time, we will be able to investigate whether their impact is differentiated according to the academic level, the scientific areas, the pedagogical methods of the teachers or according to the competences and socio-cultural origin with which the students enter the HE. In addition, by knowing the weaknesses and potentialities, such knowledge can and should provide elements to formative pedagogical actions that enable improvements in the ES aiming at the promotion and development of critical thinking in trained professionals.

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