# Can Critical Thinking Be Learned? Critical Examination of Critical Thinking

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The goal of this paper is to analyse the phenomenon of critical thinking and to examine the question of acquiring knowledge or the possibility to learn critical thinking. In particular, we want to examine which aspect(s) or element(s) of this phenomenon are subject to teaching and learning and which can at best be only slightly improved. In contrast to the unspecific and indiscriminate general view that critical thinking can be learned by nearly everyone, we argue that the answer depends on what is considered to be the nature and structure of critical thinking. In contrast to a more elaborate view that distinguishes two general parts of good reasoning, logical skills understood as the core of critical thinking, and intellectual virtues, and argues that only the former but not the latter can be subject to pedagogical teaching, we argue for the exact opposite.

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# ALI SE LAHKO NAUČIMO KRITIČNEGA MIŠLJENJA? KRITIČEN POGLED NA KRITIČNO MIŠLJENJE

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Cilj prispevka je analizirati fenomen kritičnega mišljenja in preučiti vprašanje pridobivanja znanja oziroma možnosti učljivosti kritičnega mišljenja. Predvsem želimo preučiti, kateri vidik(-i) oziroma element(-i) tega pojava so predmet poučevanja in učenja in katere je mogoče v najboljšem primeru malo izboljšati. V nasprotju z nespecifičnim in nediskriminatornim splošnim mnenjem, da se kritičnega mišljenja lahko nauči skoraj vsak, trdimo, da je odgovor odvisen od razumevanja narave in strukture kritičnega mišljenja. V tem članku dokazujemo, da teorija, ki deli dobro sklepanje na dva dela, tj. logične spretnosti, razumljene kot jedro kritičnega mišljenja, in intelektualne vrline, in trdi, da so lahko le prve, ne pa tudi druge predmet pedagoškega pouka, ne drži.

## 1 Introduction

I first encountered Rudi Kotnik at the beginning of the 20th century in one of my numerous visits to the University of Maribor. Although Rudi's field of expertise was relatively distant from my current interests, I have become aware of what a very important contribution to the development of the methodology of analytic philosophy in Slovenia he has made. Over time, we have become good friends and colleagues. I recently learned that one of Rudi's first tasks at the University of Maribor was to teach critical thinking. As I happen to have been involved in the topic of critical thinking in the last two years, it is my pleasure to contribute to his much-deserved festschrift.

The theme of critical thinking is nowadays widely used and discussed in many areas such as psychology, educational science, and logic (as the synonym for informal logic) but it is far from being a clear-cut concept, neither in its theoretical nor in its pragmatic sense. The goal of this paper is to analyse the phenomenon of critical thinking and to examine the question of acquiring knowledge or the possibility of learning critical thinking. In particular, we want to examine which aspect(s) or "element(s)" of this phenomenon are subject to teaching and learning and which at best can be only slightly improved. In contrast to the unspecific and indiscriminate general view that critical thinking is a single, indivisible human capability that can be learned by nearly everyone, we argue that the issue of its learnability depends on what is considered to be the nature and structure of the phenomenon we call critical thinking. On the other hand, in contrast to a much more elaborate view (Kotzee, Carter, Siegel, 2019), which distinguishes two general parts of good reasoning, logical skills as a core of critical thinking and intellectual virtues, and argues that only the former but not the latter can be subject to pedagogical teaching, we argue for the exact opposite, namely, if critical thinking can be taught at all, it can be done through intellectual virtues, which are an important ingredient of critical thinking.

A popular view in expert circles as well as in everyday parlance mentions critical thinking as indispensable whenever it comes to school curricula, argumentative discussion, as well as resolving different types of dialogical disputes or decision making. However, despite this ubiquity of critical thinking, its proper understanding is, we shall argue, insufficiently elaborated both in terms of its fundamental definition and in terms of its role and application. In the commonsensical usage of the term, it expresses an adamant confidence in reason, in its critical power, holding

that, when at work, it contributes to the improvement in all segments of human life. It is supposed to lead a critical thinker to truer beliefs and more correct decisions. Moreover, some are inclined to link optimistically good thinking and morality, as it is the case in Wittgenstein's dictum (*Philosophical Investigations*): Being a better person and being smarter are one and the same.

Whatever benefit one can expect from critical thinking (hereinafter: CT), the key idea is that it can be learned. But who is expected to be the subject of learning and who is supposed to teach it? The modern and popular use of the term, especially in the domain of education and pedagogy, assumes that this way of thinking is in principle available to all rational human beings (where we take 'rationally' in the broadest and vaguest sense), which includes (logically) uneducated people and school children, but also participants in scientific discourse, court hearings, etc. It is tacitly assumed that CT is something that is known, in principle and in detail (to experts), where those principles of CT should be expressed in terms of useful tools, which people should then be taught. Just like proper skiing, good driving, a successful business negotiation, and the like are taught. That CT is to be taught in terms of tools is illustrated by the note in John Shand's book, *Arguing Well*: "This book seeks to provide tools, logical and psychological, that prevent people from neglecting reason, or misapplying it, and applying them well is what they should do" (Shand, 2000, p. 3). If we teach people to apply the tools correctly, reason will be used correctly and many problems will be solved.

The point is that this presumes an all too simple understanding of CT, obscuring the need for its clarification. But that is exactly the problem. The naive understanding of CT in its avoidance of a deeper reflection on this issue threatens to become radically uncritical. This is evident in the part of the theoretical discourse that deals with this, especially in its educational-pedagogical aspect. We will illustrate this with the example of the explicit rejection of a clear definition. Davis and Barnett, in the Introduction of an otherwise informative collection of papers, emphasise: "Definitions of critical thinking are not central to areas such as critical pedagogy or critical feminism. Learning about such definitions does not help us develop a critical attitude about the society in which we live" (Davis and Barnett, 2015, p. 3).

On the other hand, the elaborate philosophical (epistemological) discourse provides a much more important and intriguing consideration of CT. Of particular importance here is a recent, highly qualified article by Kotzee, Carter, Siegel (2019)

(hereinafter: K, C, S). We shall briefly introduce their view in this introduction and come back to it for further analysis and criticism in the course of the paper.

The topic of interest of the above-mentioned paper is situated primarily in the field of education, contrasting the two, as authors see it, rival ideas. The theoretical scene is set so that two distinct concepts, intellectual virtue on one hand and critical thinking on the other, stay against each other as principle rivals. Their rivalry is seen in the two conflicting ideas: the idea of promoting intellectual virtues as a goal of education strongly contests the idea of promoting critical thinking as a primary goal of education. The authors argue that "the intellectual virtue approach does not have available a suitably effective pedagogy to help teach young people to develop better thinking skills, which, it is claimed, is a necessary ingredient of possession of an intellectual virtue" (K, C, S, 2019, p. 2).

As we are interested in epistemological rather than educational matters, the question that precedes the one concerning educational goals is how two opposing concepts, intellectual virtues and logical skills, taken to be the substantial parts of critical thinking, relate to each other. They can be considered either as coming apart, being distinct and independent, or as tightly interconnected. It seems that the authors (K, C, S), from their point of view, consider these two capabilities as distinct and independent. We will argue that critical thinking is a complex capability that includes both logical abilities and intellectual virtues. Concerning the pedagogical issue of learnability, intellectual virtues rather than logical skills are subject to teaching and learning. Moreover, the improvement in that part, in turn, can influence the enhancement in logical skills.

## 2 The origin of the concept of CT (and how it is understood?)

The very notion of CT is all but unambiguous, both in its historical use and in its modern understanding. The term CT in its modern definition has become widely used only relatively recently (in the last third of the last century). Let us precede the analysis of the modern understanding of CT with a few remarks concerning the meaning of this term over the last two centuries. The first half of the 20th century is characterised (mainly by authors belonging to the Frankfurt Critical Theory of Society, and later on by philosophers of the Zagreb Praxis School) by understanding of CT as a development of Marx's "ruthless criticism of everything existing." Invoking an even older understanding, Kantian definition of the critical approach,

we find the terms criticism, and accordingly critical thinking, understood as the study of the necessary epistemic conditions of any possible thinking. Both of these understandings will not help us in conceiving the contemporary meaning of this term. In its modern use, the meaning has undergone a fundamental shift from the previous epistemic context or the context of "revolutionary critique of the existing" to a narrower, cognitive-psychological definition of correct thinking and the ability to assess the correctness of personal or interpersonal cognitive episodes.

The severe and qualified characterisation of the meaning of CT was given by John Dewey, although he is not mentioning the term critical thinking but reflective thinking instead. He formulated the method of reflective thinking as: "Active, persistent and careful consideration of belief or presumed form of knowledge in light of reason which support it and the further conclusions to which it aspires" (Dewey, 1910, p. 9). By reflecting thinking, Dewey meant any rational inquiry, including scientific inquiry. However, Dewey's definition is composed of two distinct parts. One part concerns the intellectual endeavour (active, persistent, and careful consideration) a reflective thinker is supposed to be able to perform. The other part specifies the criteria for performing intellectual work that should be done in light of reasons that support the relationship between belief(s) and the conclusion. The latter can be sanctioned either by the rules of formal logic, by the rules of probabilistic theory, or by those of informal logic. Dewey classified the first part as personal attitudes, and enumerated them as a) open-mindedness, b) whole-heartedness and c) responsibility (in facing consequences) (Dewey, 1910, p. 31–32). We are strongly inclined to identify these two parts as intellectual virtues and logical skills that together make the practice of reflective thinking. Moreover, Dewey himself, concerning pedagogical priorities of those two abilities, relates them in this way: "If we were compelled to make a choice between these personal attitudes and knowledge about the principles of logical reasoning together with some degree of technical skill in manipulating special logical processes, we should decide for the former" (Dewey, 1910, p. 34).

Concerning the rules that give normative strength to reasons that support the conclusion, newer theories of CT chose rules of informal logic. The pioneers in linking the rules of informal logic and CT are S. Toulmin, basing what he calls working logic (Toulmin, 1958), and C. Pelerman, with a proposal for a new rhetoric (Pelerman, Olbrechts-Tyteca, 1958). Contemporary authors, primarily R. Johnson

(2000) and D. Hitchcock (2007) also take on the idea of a close connection between informal logic and CT.

In order to better understand how they consider the relationship between informal logic and CT, let us take a look at how one of the most significant contributors to the contemporary theory of informal logic and CT, Ralph Johnson (2012), interprets the reasons for the emergence of both theories. Informal logic, Johnson testifies, arose from the dissatisfaction of teachers and students with the possibility of applying the teaching of formal logic to mastering current inferential problems. In the 1970s and 1980s, a number of different articulations of the idea of informal logic emerged, followed at the same time by the "critical thinking movement." Within this movement, different definitions of CT appear. "The problem with this understanding is not simply that there are many definitions of critical thinking, but that some are incompatible with others" (Johnson, 2012, p. 6). It is also interesting to see how Johnson sees the relationship between informal logic and CT. He says, "Informal logic denotes the type of logic, while critical thinking denotes the type of intellectual practice as well as the educational ideal" (Johnson, 2012, p. 8), and continues a few paragraphs further, "then informal logic should make a significant contribution to achieving the goal of critical thinking" (Johnson, 2012, p. 9).

However, the question of the relationship between CT and informal logic and between formal and informal logic should be raised to put some more light on otherwise seemingly circular connections. Namely, CT is considered roughly as right or correct thinking (meaning the intellectual practice of "normal" human beings), while its correctness is sanctioned by rules of informal logic. However, informal logic, as we saw, is not determined by its intrinsic features, but emerges as auxiliary means for mastering reasoning in accord with formal logical rules, which an average student has great difficulties to learn. In this way, it turns out that rules of formal logic are being targeted when it comes to learning CT, and that these rules should sanction correct human intellectual practice. However, these rules cannot be easily learned. The huge gap between formal and informal logic seems to remain open. Theoreticians of informal logic and CT have widely recognised that "logical virtues" of formal logic (which is validity[1]) are not the same as "logical virtues" of informal

[1] Validity here means classical logical validity. It means that if the premises are true, the conclusion cannot be false. This also implies another important property of formal logic, monotonicity. Monotonicity requires that when a thinker forms a piece of knowledge, understood as a set of known premises, deduces a conclusion as new knowledge, added information to an existing set of premises cannot lead to a loss of knowledge.

logic (which are something quite different[2] from validity) (see, Johnson, 2000, p. 141). Consequently, informal logic, having different "logical virtues," cannot be of much help in learning formal logical rules, and in turn, formal logical rules cannot underlie the intellectual practice of CT, which is tightly connected with the rules of informal logic. It is not something that one cannot live with, but it is not quite clear whether CT theoreticians are fully aware of this.

## 3 How can critical thinking be structured?

Let us take a closer look at CT and say something more substantial about it. It seems plausible to claim that it is not a single, unstructured ability. To get a better understanding of its nature, it would be helpful to go back to Dewey's definition of reflective thinking. It is obvious that Dewey sees it as a complex and structured ability. One salient element of its structure is obviously what recent cognitive science calls *reasoning*. In short, reasoning is understood as the process of derivation by which a thinker comes to a conclusion from a set of statements or propositions. The modern standard definition of reasoning in cognitive science says: "Reasoning is a transition in thought, where some beliefs (or thoughts) provide the ground or reason for coming to another" (Rips, Adler, 2008, Introduction). Although the definition talks about beliefs, it is important to notice that, in the epistemic sense, reasoning is a process whose principal aim is obtaining a new piece of knowledge (even when we only come to a new belief, what we are really aiming at is knowledge). Reasoning, as one ingredient of CT, is a form of transition in which a conclusion is supported by reasons. This support can have different forms (deductive, inductive, abductive, probabilistic, and so on). Whatever it is, it can be described as a structure containing a set of premises and the conclusion, which can be expressed as $\{\Gamma, \alpha\}$. In its dynamic aspect, it is a process in which a reasoner is supposed to recognise that if the transition from $\boldsymbol{\gamma}_1$ to $\boldsymbol{\gamma}_n$ ($\in \Gamma$) represents good reasons for conclusion $\boldsymbol{\alpha}$, then it is justified to conclude $\boldsymbol{\alpha}$.

[2] What exactly rules of informal logic are and what forms of correct reasoning they validate or sanction is a highly contentious matter.

As it is the case in Dewey's definition, more recent theories of CT also distinguish its different aspects. Ralph Johnson (2000) for instance distinguishes the *illative core* and *dialectical tier* (understood as another tier beside the illative core)[3]. The illative core can be unambiguously equated with reasoning in its dynamic form.

We are now in the position to propose an idea of the structure of CT as a complex intellectual ability and explore the idea that theoreticians of CT should accept. The main division is between *reasoning* in the narrow sense (we borrow Johnson's term *illative core*) and intellectual virtues, which are implicitly or explicitly mentioned in many contributions to CT theories. We treat both elements of CT, the illative ability and intellectual virtues, as phenomenological or manifest levels of CT. Both manifested elements are founded by more basic, underlying elements that might be either mechanisms or dispositions. The structure can be shown in this way:

| | | |
|---|---|---|
| Manifest level | Illative abilities | Intellectual virtues |
| Underlying level | Cognitive mechanisms | Basing dispositions |

**Figure 1**

We will present each of these aspects in more detail. The illative abilities and their underlying mechanisms are presented first, and the intellectual virtues and their dispositional base afterwards.

a) The first manifest ability is the ability to perceive the supporting relations between reason and claim, that is, premises and the conclusion in an argument. Observing the supportive relationship between reason and assertion involves both the ability to form one's own arguments that the subject himself judges as "correct" (such that premises are reasons for conclusion) and the ability to judge the "correctness" of others' arguments as well. Leaving the discussion concerning the nature of "correctness" aside, the ability in question is the ability to recognise illative relations. A part of illative abilities takes place on the reflexive, conscious level, while in its significant part it takes place on the level of implicit, sometimes automatic reactions to the task the subject is facing.

[3] Although Johnson's discussion concerns the argumentative process as a multi-agents structure instead of a single-agent thinking, which is our concern in this paper, the emphasis is on his clear recognition of the complex structure of CT.

b) Whether it is a reflexive or a spontaneous level of reaction, the illative recognition is significantly determined by the underlying cognitive mechanism that governs the processes that take place on a sub-personal, more or less unconscious level. They are defined (in Stanovich, West, Toplak, 2016, p. 208) as follows:

"Cognitive abilities are types of cognitive processes studied by information processing researchers in search of a founding cognitive basis based on the performance in IQ tests. The speed of perception, the *accuracy of differentiation, the capacity of working memory and the efficiency of recalling information stored in long-term memory* are examples of cognitive abilities that underlie traditional psychometric intelligence" (my emphasis).

Although the cited section mentions general intelligence (as a significant segment of rationality), it is clear that cognitive abilities are positively correlated with the conduct of CT episodes, especially at the level of illative abilities. The better the cognitive mechanism works, the greater the ability to recognise correct illative relations. Given the problem of learning CT, we must assume that learning in the domain of CT is associated with the improvement of the cognitive mechanism, which, again, must be possible to be achieved through education. We are going to argue that this is not likely to be the case.

c) The other manifest element that takes part in performing episodes of CT is based on epistemic virtues. We take the basic meaning of the term from *virtue epistemology* (Zagzebski, 1996; Battaly, 2015; Baehr, 2011), which this discipline shares with *virtue ethics*. The very concept of *intellectual virtues* can be theoretically articulate in at least two different way. The *responsibilist* understanding of intellectual virtues (see K, C, S, 2019, p. 5) ascribes them "character traits such as *curiosity, open-mindedness, intellectual courage, and intellectual honesty are all paradigmatic intellectual virtues*" (my emphasis). According to the other, *reliabilist* tradition, advanced most notably by Ernest Sosa (2009; 2010; 2015) and John Greco (2003; 2010; 2012) " /…/ intellectual virtues are best understood as reliable faculties such as memory, eyesight, introspection and the like" (K, C, S, 2019, p. 6).

d) The responsibilist intellectual virtues philosophers, particularly Beahr (2013), connect the manifestation of virtue character traits with a disposition to carry out a particular activity. Thus Beahr (2013, 249) in a somewhat more formal expression, claims that "for every intellectual virtue V, the subject S possesses V only if S: (a) is

disposed to express a particular activity or psychological characteristic of V (b) (and does so) out of love for epistemic goods."

It is very interesting to notice that in the field of cognitive science, Stanovich, West, and Toplak (2016), talk about the dispositions of rational thinking instead of dispositions for intellectual virtues and illustrate them with examples that are quite similar to Beahr's. It is hard to oversee the similarity between them. Here is how Stanovich, West and Toplak connect the forms of rational thinking with adequate dispositions:

"Dispositions of rational thinking are those that relate specifically to the adequacy of belief formation and decision-making. Examples of rational opinion dispositions include the disposition to evaluate (weigh) new records versus firmly rooted beliefs /…/, the disposition to devote a good portion (or short time) to a problem before giving up, or the disposition to evaluate the opinions of others when forming one's own" (Stanovich, West and Toplak, 2016, p. 208).

## 4 Learnability of CT

Coming back to the issue of learnability, the question arises as to what one should learn to successfully manipulate the performance of CT? Does the illative ability (including acquiring skills or knowledge of the rules) suffice for CT, or should something else be added to it? We are also asking the stronger question: can illative abilities as such be significantly improved by learning? Concerning the first question, one can be sufficiently persuaded with Dewey's claim. To remind ourselves, he said "If we were compelled to make a choice between these personal attitudes and knowledge about the principles of logical reasoning together with some degree of technical skill in manipulating special logical processes, we should decide for the former" (Dewey, 1910, p. 34). Concerning the first question, we are quite satisfied with his view. Regarding the stronger question, we are going to answer in the negative, and in the rest of this paragraph we will offer supportive evidence of this claim.

Illative abilities in our proposed structure of CT are basically inferential abilities and have been the subject of by far the most extensive study over more than four decades. Extensive psychological and cognitive literature created in this period have experimentally confirmed the extremely sceptical attitudes both with regard to the

inferential ability possessed by an average thinker and with regard to the possibility of improving (learning) these abilities. I am going to mention only the most famous researchers, whose results have been replicated countless times. It is primarily Wason's experiment, called the selection task, and the research of Kahneman and Tverski. Wason's experiment shows that people cope extremely poorly even with elementary deductive tasks (over 95% of respondents solved the task incorrectly), while the research by Kahneman and Tverski documents shows equally poor results in the field of induction (let us just mention the so-called Linda problem) and base-rate reasoning.

It is important to note that the mentioned researchers judge the human ability to reason according to the standards determined by the rules of formal logic (in the case of deductive reasoning) and formal rules (axioms) of probability theory (in the case of inductive and Bayesian reasoning). Given these standards, it turns out that people are, if not irrational, then at least sub-optimally rational. These results are by no means unexpected. Namely, the principles of classical formal logic are too demanding to measure human rationality. Its two basic principles, deductive closure and monotony, are extremely unintuitive as principles of (human) reasoning. Given these results, it seems helpless to insist on reconciliation of bounded, limited human reasoning powers and high normative standards. This is particularly the case when it comes to the question of learnability.

Of course, human inferential ability can be measured by different standards. Namely, already at the time of formulating Wason's task of choice, many critics noticed that the problem could lie in the formulation of the task rather than in human ability. Wason's original task was formulated in abstract terms of numbers and letters. The experiments that followed replaced the abstract numbers and letters in the task with concrete terms that are more familiar and relevant to the average respondent for making a conclusion. With the task formulated this way, the results improved drastically. Does this mean that human illative abilities are still reliable and that they can be learned? Unfortunately, that is not the case. Numerous experiments have shown that, while it is true that respondents infer better in a context that is familiar to them, what is important is that they remain extremely prone to errors in contexts that are more distant and unknown to them.

The value of critical thinking lies in the possibility of applying inferential skills to different familiar and unfamiliar contexts. The domain of the application of critical thinking cannot presumably be limited to a narrow area familiar to the thinker. The critical thinker should demonstrate the ability to think critically in a variety of contexts, not just those one is familiar with. The dominant opinion within cognitive theory concerning a wider domain of application is that it is unrealistic to expect improvements or ameliorative shifts in such an inferential domain in either deductive or inductive area. Particularly, it is unrealistic to expect this by learning the "correct" rules of reasoning and pointing to the so-called logical errors, as is often naively assumed in theories of critical thinking.

Let us return to Kotzee, Carter, and Siegel's thesis. They strongly argue that critical thinking should be promoted as a goal of education, while intellectual virtues should not, because "the intellectual virtue approach does not have available a suitably effective pedagogy to help teach young people to develop better thinking skills" (K, C, S, 2019, p. 2). Let us take a closer look at their argument. In a nutshell, the teaching of correct thinking can be done either by giving a rule-like description or by teaching through examples. K, C, S hold that rule-like description is easily available in teaching critical thinking, while the teaching of intellectual virtues can be done only by examples. Let us see why: "What is virtuous is relative to the situation that one finds oneself in and is also relative to who is performing the action. A teacher can make clear what the virtuous thing to do is only by holding up an example of a virtuous action and encouraging young people to copy that example in practicing how to be virtuous" (K, C, S, 2019, p. 11). Linda Zagzebsky also claims: "We learn through narratives of fictional and non-fictional persons that some individuals are admirable and worth imitating /.../" (Zagzebsky, 2017, p. 15). After a careful and illuminating analysis, Kotzee, Carter, and Siegel express their dissatisfaction with the "exemplarist" approach in teaching intellectual virtues in this way:

"In sum, our worry about teaching of the intellectual virtues is this. Advising children to be intellectually honest, brave or rigorous if they want to become intellectually virtuous thinkers and enjoining them to imitate intellectual exemplars does not amount to specific advice regarding how they can improve their thinking. This is especially so if the student is, for the moment, quite far from being intellectually virtuous" (K, C, S, 2019, p. 20).

To summarise their argument in a very rough form, yet sufficiently well to point out where exactly we disagree with the authors, it could look like this:

1) Teaching of correct thinking can be done either by giving a rule-like description or by teaching through examples.
2) Concerning critical thinking, it can be efficaciously taught by rule-like description.
3) If intellectual virtues can be taught at all, it can be done only by examples.
4) Teaching by examples does not amount to pedagogical improvement of correct thinking.
5) Therefore, teaching intellectual virtues does not have sufficient pedagogical resources.

The premises 2 and 3 are those where we disagree with the authors. To explain our disagreement with a claim in premise 2, a more careful consideration is needed.

Talking about teaching critical thinking (in our terms, illative ability), it consists, the authors claim, in teaching "why it is good (and why uncritical thinking is bad)," and this teaching can be achieved "both in terms of general criteria sanctioned by logic (both formal and informal), probability theory, and epistemology, and of subject-specific criteria sanctioned by particular subject areas" (K, C, S, 2019, p. 20).

Let us compare the authors' understanding of critical thinking with our analysis. According to our analysis, what they call critical thinking can be equated with illative abilities. Those abilities are manifested as the capacity to perceive the supporting relations between reason and claim (premises and conclusion). They, in turn, are enabled by underlying mechanisms that are very like what Stanovich, West and Toplak defined as the speed of perception, the accuracy of differentiation, the capacity of working memory, and the efficiency of recalling information stored in the long-term memory. All those mechanisms are sub-personal, which, as Reber (1993) noticed, "have low variability and do not show a significant relationship to analytic intelligence." Hence, to expect that they can be easily learned by teaching what is good and what is bad thinking is rather too optimistic.

Concerning the general criteria that sanction good thinking, the authors say that they are both formal and informal. Regarding the formal ones, we saw that informal logic was introduced because students had great difficulties in learning formal rules.

Formal rules are too demanding to be taken as a criteria for good thinking. Regarding the informal ones, they have different "logical virtues" from the formal ones. As such, they are of little help, except locally, when reasoners perform inferences in familiar contexts.

Concerning premise 3, we partially disagree. We agree with the claim that teaching intellectual virtue by examples cannot significantly improve critical thinking. What we disagree with is the claim that it is the *only* way of teaching intellectual virtues. By intellectual virtues we mean the *responsibilist* ones that Baehr enumerates as inquisitiveness, open-mindedness, intellectual courage, and intellectual honesty. They cannot be taught through examples, but they can be acquired through argumentative practice. Argumentative practice can easily take place in the classroom. Through such practice, a student can, by a number of successive trials and errors, learn on their own example what the epistemic value of, for instance, intellectual courage or intellectual honesty is. It should be noted that we are not overly optimistic even in regard to this method of learning, but we believe that if critical thinking can be improved at all, this can be done in this way.

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