




Logic as a Tool for Developing Critical Thinking
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Logic as a Tool for Developing Critical Thinking

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Abstract

A characteristic feature of modern society is the ever-expanding information space. Hidden information attacks harm the lives of individuals and society in general. In this regard, studies of critical thinking seem particularly important to us. Therefore, critical thinking is interpreted in the academic discourse mainly in connection with the effort to cope with the growing amount of misinformation and hate speech. While teachers and policymakers consider critical thinking an important educational goal, many are unclear about developing this competency in a school setting. For many key competencies, the question is whether and how they can be acquired through planned educational courses/programs. Although there are specific training programs for critical thinking as a core competency, their design and effectiveness are scientifically controversial. Instruction in critical thinking becomes extremely important because it allows individuals to gain a more comprehensive understanding of the information they encounter and promotes good decision-making and problem-solving in real-world applications. Despite the ambiguity of the term critical thinking, its close connection with logical culture is evident. Logical culture is the culture of thinking manifested in the culture of written and oral speech. The starting point for developing critical thinking skills should be logic. Logic as a science of correct thinking is the basis on which the program for developing critical thinking is based. The paper's main aim is to identify the status of critical thinking as an independent discipline. A partial aim of the paper is to define the relationship between critical thinking and logic. The paper is divided into six parts, while the main findings are summarised in conclusions. In its purest form, logic does not teach how to work with a changing context or apply it to the subject realities of various disciplines, but such characteristics as precision, clarity, provability, and persuasiveness are key for this science. It is through logic that the basic principles of thinking, which we call critical, are revealed, the rules of argumentation and definitions are explained, and misconceptions and errors are displayed. Logic is distinguished from other sciences by the fundamentality of the discussed problems. Logic is the only science that combines mathematics, computer science and humanities education. We believe that modern logic is only the beginning of the first of the sciences of a new generation, which will be invited to combine the analyticity of the scientific method with the synthetics of perception of the humanitarian point of view. Therefore, we believe that the development of critical thinking skills appears to be productive in combination with the study of logic and is a priority in the modern educational process. It is difficult to imagine the formation of critical thinking in isolation from the building of the logical culture of the individual, which gives him a solid foundation for understanding the essence of critical thinking.

Keywords: Logic, Informal logic, Critical thinking, Cognitive theories, Teaching Logic, Competencies.

Introduction

Several experts (World Economic Forum 2018, Vincent-Lancrin et al. 2019), in connection with significant competencies, with enviable consistency, point to critical thinking, which in the age of abundance and easy access to information enables its selection, analysis and evaluation. Research about critical thinking usually indicates the results to which it should lead, namely the ability to navigate an endless stream of information (data, opinions, etc.), choose the important, defend your opinion, listen and evaluate the interlocutors' positions, and remain impartial. Teachers and trendsetters consider critical thinking an important educational goal, but many are unclear about developing this competency in school.

The concept of critical thinking is somewhat vague, but at the same time, its close connection with the level of logical culture is evident. This connection becomes apparent when looking at critical thinking from a historical perspective. The core of critical thinking can be found in the philosophy of the Enlightenment, which changed the course of history and forced, according to Battersby (Battersby 2016), to appeal to scientific thinking and rationality. At the same time, critical thinking should not be identified only with logic in its usual sense. In addition to formal logical knowledge and a certain level of general education, it presupposes the ability to remain dispassionate and to evaluate opponents' arguments as one's own. These principles can be drawn from the critical writings of Kant (Kant 1996).

The paper's main aim is to identify the status of critical thinking as an independent discipline. A partial aim of the paper is to define the relationship between critical thinking and logic. The literature on critical thinking has its roots in two basic academic disciplines: philosophy and psychology (Lewis and Smith 1993). Classical philosophy correlates this competence with the level of an individual's logical culture (assuming an excellent general educational level). We will show that such an assessment is still relevant today: this is also confirmed by modern cognitive theories, which have contributed significantly to contemporary ideas about the place and methods of learning critical thinking.

Logic and critical thinking

Without understanding what exactly is hidden behind the content and scope of the term critical thinking, it is pointless to talk about the need to restructure the educational process. However, it turns out that defining critical thinking is far from trivial. Critical thinking involves inductive and deductive reasoning, making correct analyses, conclusions and evaluations (Facione 2000). The components of cognitive abilities are intertwined with social and emotional skills (reflection and evaluation within the cultural context, moral attitude and integration with one's own goals and values) so closely that it is difficult to separate them and assign them to one or another category. Prototypes of critical thinking were created in ancient times. Over the past centuries, this concept has accumulated so many semantic nuances that it is impossible to include them in a single formulation. Some researchers identify it with logic and applied epistemology, others with the decision-making process; some discuss critical thinking in the light of normative approaches, and others insist on the importance of the descriptive component (Babii and Neculau 2019). One gets the impression that this term is overloaded with meaning.

However, it is possible to provide some preliminary definitions of critical thinking. We propose to consider it a habit of thinking that allows processing information in a certain way. Ennis (2013) talks about the types or methods of such processing, according to which we talk about rational reasoning that helps determine what to believe or do. Battersby emphasises its explicit limitation to epistemological norms, such as defining and eliminating errors and analysing and evaluating arguments (Battersby 2016).

Like all thinking, critical thinking is expressed in language. Let's look at the signs of possessing critical thinking (the ability to formulate and defend one's position rationally, understand what is heard/read, and assess it as objectively as possible). Critical thinking should be connected with a rational assessment of the legitimacy of reasoning, which also traditionally deals with logic. Finding a person who would never make logical mistakes in his reason is probably complicated. There was a time when the analysis of logical fallacies in argumentation and the rules of correct reasoning played an essential role in education and science. In the 20th century, in connection with the formalisation of logic, this task receded into the background. The logic closed in on itself and ceased to be clear to many. Modernisation conceived logic as a part of mathematics and emphasised propositional and predicate calculus. Unfortunately, even from the content of several logic courses, the term judgment has disappeared. Which appeared in logic back in the time of Aristotle and on which the logical foundation of natural language rests, as if on a foundation. This fact did not contribute at all to the development of the company's analytical culture. Many of us are not at all worried that at the same time as the massive expansion of information technology, there is more than enough logical nonsense that we encounter in several areas, starting from politics and legislation and ending with court cases in which contradictory judgments are issued.

The connection between critical thinking and the skill of logical analysis can be traced almost throughout the history of the development of philosophical thinking. Prototypes of the term's modern connotations can be found in Socrates' famous method of questioning (Corcoran 1999), and certain shades appear in medieval disputes. However, a current, more accurate understanding of critical appears in the Modern Age, when logic begins to be considered a method to discover new knowledge. This is the time of the emergence of practical logic (Arnauld 2012), the birth of scientific knowledge, and the time of the Kantian revolution, which proposed such an understanding of criticality, which even today can be considered a model (although the very meaning of this term at that time was significantly different from of what we tend to understand by critical today).

Modern symbolic logic, with its complex formal apparatus and distancing itself from philosophy, has made the subject connection less obvious: logical formalisms have become too complicated for non-logic students to master, their philosophical burden has lost its obviousness, and therefore other opportunities are sought for the development of critical evaluation skills. It seemed that the way out was found after the creation following the argumentative currents of informal logic (informal logic). Formal logic began with Frege as a revolution at the level of theory, which later translated into logic textbooks. The development of informal logic at the theoretical level was motivated mainly by an effort to teach students how to evaluate arguments. (Johnson and Blair 2002, 352). As Blair, one of its founders, correctly noted in the 1980s, the term critical thinking began to be actively associated with the term informal logic: it was this term that served as the name of courses developed for universities to teach students critical thinking skills (Blair

2011, 5). This is still the case to some extent, although one cannot fail to notice that there is a tendency to separate these terms nowadays.

The rapid development of cognitive sciences partly conditions this trend. Today, there is great interest in everything related to the perception, processing, and evaluation of information, which gives rise to a justified effort to immediately find practical applications of the discoveries of cognitive sciences in education. These studies revealed the social nature of reasoning, the tendency of people to make irrational decisions, etc. It has been shown experimentally that humans are not very good at deductive reasoning, so one might think that logic can be set aside for understanding human communication (Griggs, Richard, Cox and James 1982, Manktelow and Over 1991). As a result, modern approaches began to displace the traditional model of rationality established by the philosophy of the Modern Age and the Enlightenment, in which rationality went hand in hand with logic and deduction. The classical model, embodied in the classical philosophy of science, turned out to be too narrow for modern research. The studies of the last decades forced us to talk about a pluralistic approach to rationality (Dutilh Novaes 2012, 147), which, however, does not mean a complete rejection of its classic understanding of the Modern Age: different types of rationality if they coexist with each other, then as a rule are centred around established patterns. In this case, rejecting logical practices in favour of pluralism of rationality does not look convincing (Bobrova 2018).

We may need some time to understand and define the term clear critical thinking but to interrupt the connection of this meta-skill (as it is sometimes defined today) with logic in the educational process until then would be unjustified and irresponsible. A certain number of experiments operating under artificial conditions cannot undermine the centuries-old authority of this science, and logic courses are unlikely to be too old-fashioned: the content of current logic courses is exceptionally diverse.

Logic answers many of the challenges posed by psychologists decades ago, and these answers are sometimes quite non-trivial. The rejection of logical knowledge in favour of critical thinking courses undermines the basis of the opportunity to develop the relevant competence itself. Suppose the fundamental logical component is omitted due to the unclear understanding of the term critical thinking and the indeterminacy of the disciplinary status of this subject. Its factual and practical components will inevitably be blurred (Bobrova 2018).

Comparing informal logic and critical thinking

Critical thinking (critical thinking, critical reasoning) is often identified with informal logic, especially in Anglo-Saxon countries (Jauris 1992, 3). This identification has its good reasons: both informal logic and critical thinking aim to refine and improve the linguistic expression of ideas (working with concepts and their ambiguity), to enhance argumentative skills, both when analysing other people's arguments and when formulating one's arguments, to educate personalities capable of independent and reasoned decision-making – with which resistance against manipulation and ideologies of all kinds is connected. However, we also find significant differences between the two directions:

1. Logicians practice informal logic, while teachers cultivate and promote critical thinking. This fact has far-reaching consequences. Logicians tend to apply logical systems, rules of correct judgment,

and perfectly defined concepts to the world. They look for theoretical regularities in natural language. When they don't find them, they criticise the language or, even worse, invent examples in which the logical frequencies work and ignore the other cases.

2. On the other hand, teachers of specific subjects proceed in the opposite direction – they have a flood of information, facts, and knowledge (expressed, in other words, in language) and try to bring order to this flood. Criticism and a critical view then (logically) refer to specific claims and specific arguments and not to language expressions in general. The central dilemma in this area is that a sound reasoning principle in one context may be flawed in another. If we focus on judging regardless of the topic (topic-neutral reasoning), we find ourselves back on the ground of the original, uninteresting and impractical formal logic. (Shuster 2018).

3. Concreteness (binding to the content) is the second significant difference. Informal logic examines all expressions (arguments) of a given type as if at once, and it is difficult to cope with the multitude of linguistic terms for the same idea. Finding general rules for appropriate, correct, and unambiguous expressions is complicated. As a result, books on informal logic are primarily concerned with errors (errors in argumentation, errors in definition) and the categorisation of correct judgments and reports. Although critical thinking also aims to express an idea precisely, it takes care of specific ideas tied to a particular topic. Because of this, critical thinking offers many methods by which one can progress from a crudely expressed idea to a polished expression. Logic does not know this because there are no general rules for formalisation. Formalisation can only be applied to specific content and assumes substantive knowledge in addition to language skills. After completing the logic course, almost all students mastered the required manipulation of symbols. But when given an example of common argumentation (philosophical text, journal article, etc.) to analyse, which is relatively new, many fail.

4. Another difference, breadth of context, is related to substantive knowledge. Informal logic remains in its analysis at the level of words, individual sentences, or a few sentences that form a coherent judgment. However, texts (and other sources of information) in real life are significantly more complex: they are longer, they contain information that is not related to each other, and the factual side of the announcement is interwoven with the evaluative attitude of the speaker (writer), they work with unexpressed thoughts. These are the things that critical thinking does – it offers tools of analysis that can be applied to continuous texts, entire books, or any more extensive body of information. This is not to say that critical thinking is better than logic – it is somewhat more flexible precisely because it does not demand perfection – it seeks a better and more precise expression of ideas, not a perfectly unambiguous and formally unassailable expression.

5. The last significant difference between critical thinking and informal logic lies in the relationship with the addressee (pupil, student, discussion partner). Logic considers its rules universally applicable in that every language user can adopt them and enrich and improve their thinking (expressing themselves clearly, arguing clearly). On the other hand, critical thinking recognises the principle that everyone must think for himself and use his head, that a relationship of individual ownership to ideas is necessary (Jansa 2003).

The above differences can be summarised in the following points:

- Informal logic and critical thinking are not the same thing.

- Informal logic is more of a scientific discipline (general), while critical thinking is more of a human competence, the ability of a specific person.
- Critical thinking uses the knowledge of informal logic (in addition to other, less scientific procedures).
- Informal logic is a solid, generally valid (and therefore also visible) core of our critical thinking.

Informal logic mainly shows us the possibilities of incorrect argumentation and arms us against such argumentation. (Jauris 1992, 31). Symbolic logic offers simple theory, agile techniques and rules. The problem arises when we try to apply it to everyday thinking to show its usefulness. Everyday reasoning is better studied with the help of informal logic and critical thinking methods. (Shuster 2018, 447). But the study of logic also has its broader utility. Whoever solves logical problems in outside-of-logical subjects and everyday life will soon develop several invaluable subconscious habits:

1. The habit of thinking in precise and clear terms consists of subconsciously asking such questions as: What does this expression – strictly speaking – mean? What does this person mean? Isn't this term ambiguous? In what ways can it be understood? Isn't this term used with different meanings here? What do I need to clarify? What definitions do I need to look up to understand this term? How could we explain this concept so it can be worked well with? What is this interpretation: conceptually accurate and clear, or is this not a proper clarification, so it cannot be understood and is useless to listen to?

2. The habit of checking the correctness of the judgment consists of asking questions of this kind: Is there not a dispute in the interpretation? Isn't there something obvious? i.e. does it not follow from what has already been said? Isn't there a judgment in this statement, the reason for the conclusion, the explanation? Is it correct? Were the premises well-reasoned? Does the proponent of the argument justify everything that is not obvious? Or is he simply asserting something without bothering to explain it? Or does he instead only care about suggestive means of persuasion? Logic, knowledge of social laws, and an appropriate system of values (the ability to distinguish between good and evil, better and worse) constitute the necessary preparation for modern citizenship (Jauris 1970, 167).

Psychological experiments and logic

The constant growth of data accumulated by science since the second half of the 20th century, proving that people do not always follow logical forms, somewhat shook the position of logic in the general knowledge system. It turns out that first, people's reasoning depends on context, and second, people don't always correctly identify the logical form. Regarding the issue of logical structure, Wason's experiment (Wason selection task) from 1968 (Wason 1968) appears to be very representative. Such experiments force us to discuss the relevance and context dependence of reasoning. It should be emphasised that in logic, it has not been a decade since they were discussed in the formal contexts within the symbolic approach and at the content level. Logic is not a rigid science that rejects all discoveries of related disciplines sceptically. The study of contextual dependencies is facilitated by, e.g. working with modifiable judgments (non-monotonic inferences) whose assessment depends on external factors (Prakken and Sartor 1997, Over and David 2009). To date, many studies are devoted to the issue of the logical form.

Somewhere, this problem is discussed at a general philosophical level (MacFarlane 2000), but at the same time, completely formal solutions are offered (Caminada 2008). Much literature on this issue can also be found in the informal dialectical approach (Walton and Godden 2007, Macagno and Walton 2016, Macagno and Walton 2018). In all works, the authors must not question the foundations of logic and accept known logical structures but show how the problems of the relevance of contextual dependencies can be solved within the available possibilities. The current situation allows us to consider the diversity of approaches to understanding logic in general and logical form in particular.

Contextual dependence is also conceptualised in the literature on critical thinking. Maynes discusses the advisability of introducing the concept of ecological rationality, i.e., rationality evaluated considering the context (Maynes 2017). On the one hand, this approach correlates well with the pluralist approach to rationality within philosophy, with the context dependencies that logic studies. Moreover, it is also consistent with cognitive-psychological concepts such as the theory of mental models (Stenning 2001, Stenning and van Lambalgen 2007, López-Astorga 2018) – people think in terms of models created by their knowledge and ideas about the world. On the other hand, this reasoning contains technical complications: first, it is pretty challenging to evaluate rationality in each specific case because there will always be an infinite number of issues; secondly, one interlocutor's understanding of the situation, that is, his model, does not necessarily coincide with another's understanding of the situation, which makes the principle of comparison and evaluation unclear. One of the few solutions can be seen in the classification of the cases themselves, which is a serious work in itself, an example of which can be found in the works of Walton (Walton 1989), devoted to the typification of dialogues. However, this solution returns us to the realm of logic.

So, the experiments, which in their time undermined the belief in the classical foundations of logic, should not only discourage psychologists and, with them, teachers from logic but, on the contrary, should put logical problems and methods in the foreground.

The philosophical approach

When we talk about logic as a tool, it should not be forgotten that it does not replace philosophical principles that determine the direction of work. That is, they contribute to the development of critical thinking. When combining critical thinking with creativity, e.g. Baumtrog proposes to follow these four reasons: first, different approaches and angles to consider the problem. Second, the relevance of these angles. Third, recognition of the value of each of the proposed relevant positions. Fourth, this skill is crucial in groups expressing one's work clearly, consistently and confidently (Baumtrog 2017). Baumtrog correctly notes the third point as the most difficult. However, if we turn to the history of philosophical thought, he raised questions before, and his discussion was always crucial.

What can philosophical thinking offer to understand the principles of critical thinking? The scope, the focus of essential thinking functioning, and the associated expectations are not too different from scientific knowledge and rationality, which replaced the old ideals of the Enlightenment era. This similarity allows us to consider the project of critical thinking as the heir to the project of classical philosophy (Battersby 2016, 100).

First, Kant discussed the critical problem at a high level. Kant is not talking about critical thinking but about a method that determines the possibilities and expands the boundaries of human knowledge. The technique makes the boundaries of critical thinking visible, making it possible to formulate a set of tasks and opportunities quite clearly, contributing to understanding the essence of critical thinking and education issues.

Kant does not speak directly about the method either: no work is specifically devoted to this issue. What he put into the understanding of critical and how the critical approach differs from polemical, dogmatic, and sceptical can be judged based on the reconstructions of modern researchers. None of the methods goes beyond the essential, whose work presupposes the internal independence of the subject (Hinske 2023). The principle of the critical approach is based on the scientist's ability to abstract from his internal evaluations and preferences and to put aside intellectual snobbery to assess the content value of the opponent's position. Such steps make it possible to enrich the initial knowledge, which is the scientist's primary goal.

It is worth noting that Kant can be partially heard in the provisions mentioned above of Baumtrog, with the only difference that Kant not only points to the difficulty of implementing the third point – recognition of the value of each of the proposed relevant positions – but puts this point in the foreground. This already gives reason to assume that understanding the work of his method would significantly advance us in the search for a solution to this problem.

But here, there are problems of a different kind. The method does not delve into the principles of its operation. And if Kant does not consider it necessary to write specifically about the critical process itself, then it would be naive to hope that direct indications of the principles of its work can be found in his works. Meanwhile, the maxims of human reason (in the broadest sense of the latter) make it possible to approach its understanding: the sayings of independent thought, to think by putting yourself in another person's shoes, and always believing in following yourself. The first maxim governs the need to distance oneself as much as possible from subjective evaluations. The second requires the most impartial perception of the positions of others. The third maxim points to the rules of enriching one's knowledge with knowledge received from others: such enrichment should occur in the most consistent form possible (Kant 1996).

Following the maxims indicates the direction in which the emergence of an internally independent subject is possible in principle. As for the technical side – the sequence of presentation of positions, their justification and evaluation – here we are again forced to turn to logic. At its core, the critical method contains the conveniences of both dogmatic and sceptical methods: "And the critical method appears, that is, I examine the sources of the sceptical and dogmatic methods..." (Kant 1996, 885). So we return to the thesis about the importance of logical culture, expressed at the beginning of the article. And it turns out that Kant's method is modern: it sets a standard that allows the individual to develop the skills of what is commonly called critical thinking.

It should be noted that critical thinking, the foundations of which were laid by Karl Popper, turned out to be one of the most actively developed research programs in the second half of the 20th century, often even independently of Popper's concepts, which is not so important, since those concepts implicitly came from his fundamental ideas (Waller 1998). In his discussion of the critical function of logic, Popper makes a claim whose importance cannot be overstated, especially now that wars are raging and terrorism is prevalent across our planet. "Critical reason – is the only

alternative to the violence we know of today...we are discovering a new fundamental opportunity: our tests, our testing hypotheses, can be critically eliminated through reasonable discussion without eliminating ourselves. This is the point of reasonable critical discussion. If the method of reasonable critical discussion triumphed, violent methods would be a thing of the past." (Popper 1994, 80). We will certainly all agree with these words of Popper

Conclusions

So the term critical thinking is used so actively today that its content blurs. On the one hand, it appears so self-evident that it seems as if there is no need to define it. On the other hand, any attempt to offer a coherent definition fails. There are several reasons for this, both historical and interdisciplinary. In any case, it is pretty challenging to ignore the problem of critical thinking: it turns out that critical thinking is too integrated into modern education.

Despite many psychological experiments and cognitive theories, the development of the skill of critical thinking should be connected, as before, with the improvement of logical culture. Although critical thinking works best in groups, it is also possible for individuals to increase their critical thinking skills. A beacon in this matter can be the method proposed by Kant, thanks to which the one who owns it will be able to go beyond existing ideas, rebuild his mental schemes, perceive the mental worlds of partners and build something new, much more demanding. Implementing the method, regulated by the maxims of reason, directly depends on the logical culture.

So there is undoubtedly a substantial connection between critical thinking and logic, but they are not identical. Logic is a science with its subject and tasks. It has long been an integral part of education and allows students to develop the skills of evaluative reasoning and logical analysis of written or oral speech. These skills are certainly at the core of critical thinking. But critical thinking also includes skills one is not likely to acquire by taking a specific course. The ability to keep an open mind and evaluate opponents' arguments as one's own, as Kant writes, reflecting critical thinking, is instead an accurate result of the general education and upbringing of the individual. Thus, we think that a stand-alone course in critical thinking is unlikely to be the best alternative to regular logic courses that show their effectiveness over a long period. However, centuries of history do not mean that logic courses have remained unchanged. Studies have been repeatedly reviewed; therefore, it can be assumed that such changes will occur. How should logic be taught to create the necessary prerequisites for using the critical method? This question probably deserves a separate article.

The proposed return to logic and philosophy has several significant advantages. Today, critical thinking is studied by many disciplines, most of which rely on descriptive methods. The teaching of critical thinking should consider as something normative, and precisely logic and philosophy can offer such normativeness. They show why critical thinking, regardless of how much it depends on society, should be considered a normative ideal, the achievement of which depends on each person. "Critical thinking is a normative ideal. It is a set of epistemic attitudes and/or practices individuals should strive for. It is also a set of attitudes and practices we try to instil in our students." (Maynes 2017, 114). They should be able to think about arguments independently of their desires and prejudices. They should be sceptical of appeals to authority and distinguish between epistemic and non-epistemic sources. They should be open to evidence and not look

only for evidence confirming their preconceptions. They should also respond to evidence and change their beliefs based on the best available arguments.

The starting point for developing critical thinking skills should be logic. Logic as a science of correct thinking is the basis on which the program for developing critical thinking is based. In its pure form, logic does not teach how to work in a changing context, as it should be applied to the subject realities of various disciplines. However, this science is crucial for concreteness, precision, clarity, and validity. The basic principles of thinking, called critical, are revealed through logic, the rules of argumentation and definition are explained, and misconceptions and errors are displayed. Therefore, it is legitimate to consider logic as a tool for developing critical thinking.

Despite the ambiguity of the term critical thinking, its close connection with logical culture is shown. Logical culture is the culture of thinking manifested in the culture of written and oral speech. When we think about logical culture, we focus on these skills that a person uses in a specific mental practice. We are talking about logically competent handling of concepts, correct logical operations with statements, strictly constructed judgments, argumentation and evidence. We can judge a formed logical culture when a person acquires the skills of rigorous analysis of other people's reasoning, finds logical errors, and uncovers misconceptions and language traps.

So developing critical thinking skills seems to be productive in combination with the study of logic. It is difficult to imagine the formation of critical thinking in isolation from the growth of a person's logical culture, which gives him a solid foundation for understanding the essence of critical thinking. Logic helps improve the skills of rational analysis and critical evaluation of incoming information. Logic is an essential tool for developing human critical thinking, but it cannot be equated. Logic is a separate independent science, while critical thinking is a unique method of reasoning based on logical rules. For this reason, stand-alone essential courses of thinking cannot be considered adequate. Practical critical thinking requires solid logical skills.

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