DOI: 10.21847/1728-9343.2020.5(169).213219

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THE ROLE OF LOGIC IN CRITICAL THINKING

The article focuses on two things: the main difference between Critical thinking and Logic as the academic subjects and between Critical thinking and Logical thinking as two somehow similar, but nevertheless, diverse ways of rational thinking. The author stands that the false association of these two thinking manners influence on how both disciplines are taught. Unfortunately, in Ukraine, Critical thinking is neglected. Often Ukrainian universities replace it with some courses on Formal and Informal Logic. Furthermore, the existing Ukrainian manuals on Critical thinking are all devoted only to the logical issues. Although Logic can give some significant and useful tools, the author emphasizes that it is not sufficient for the correct usage of Critical thinking. Therefore, the author analyzes the main characteristics of Critical and Logical thinking. Using the table method, the authors indicate which features both thinking manners have in common and which are different for them. This table of comparison clearly demonstrates that Critical thinking and Logical thinking are not the same. Moreover, the author shows the roots of the established terminological misunderstanding in human society by studying the history of two subjects: Critical thinking and Informal Logic. Western science had already divided these disciplines and identified the main priorities and challenges for each. However, in Ukraine, we still have some "separation problems", because of the glossary absence and the false association of two ways of rational thinking. To prove the declared similarity wrong the author studies two recently widespread fake news about COVID-19. The author debunks both COVID-myths by using different means given by Logic and Critical thinking showing that both of them can be used independently one of each other. The author stands that Critical Thinking is a very important skill, especially, during a pandemic time. Therefore, it is extremely important that it is taught and used in the correct manner.

Key word: *Critical thinking; Logical thinking; Formal Logic; Informal logic; COVID-19.*

Introduction

Habitually people identify critical thinking as logical. Nevertheless, there will not be two notions if there was no difference. Often logical thinking is considered as natural human capacity as breathing. However, the researches in behavioral psychology and economics proved that the initial thesis was wrong. Human beings are partly rational creatures (see *Simon, 1955; Johnson-Laird,1980; Kahneman, 2011*) and we are needed to be taught to start thinking logically (see *Geach, 1979; Epp, 1996; Bako, 2002*). Logic as a "man-made" construct and logical reasoning is rarely met in real life. What about critical thinking? To have a tendency to judge or evaluate things does not make you a good judge. Even so Critical thinking is more common in real life; it still needs to be guided as well as good logical reasoning.

The guidance could be found in two different disciplines: Logic and Critical Thinking. They may help people to master logical and critical thinking accordingly. Western society had already divided both subjects and emphasized their focus and purpose. While Ukraine is only getting in this way. The first steps had already been made (see *Chuba, 2013; Ushchapovska, 2013; Bondar, Yacenko, 2019*) Nevertheless, there is still a big confusion with the term of "critical thinking" that reduces it to one of the varieties of logical thinking, which is fundamentally wrong. This problem has its historical roots, which would be discussed later in the article. Thus, this topic is relevant because of the lack of a clear understanding of what is the Critical Thinking in Ukrainian scientific society.

Therefore, this paper represents two principal questions. On the one hand, I demonstrate the main differences between Critical Thinking as an academic subject from Logic. To do so, I need to differentiate first the two kinds of academic Logic: Formal and Informal Logics. Formal Logic is the "study of propositions, statements, or assertively used sentences and of deductive arguments" (*Hughes, Schagrin, 2018*). Its main interests are the correct formalization of reasoning and the validity of inferences. Although Formal Logic did not succeed in capturing the real process of thinking (because of its usually chaotic and unpredictable nature), not to mention to improve it; Formal Logic had contracted the stable grounds for the programming and the AI development. At the same time, Informal Logic tries to "understand and improve thinking, reasoning, and argument as they occur in real-life contexts" (*Groarke, 2017*).

Critical Thinking as well as the Informal Logic also interests in that kind of thinking that happens in real life. Both of them pay attention to the proclaimed speeches. However, there is a difference in the aim. Critical Thinking studies it to produce a new train of thought. While the Informal Logic is interested in the speech itself. Comparing with the Formal Logic, they don't have common inter-

ests. Nevertheless, Critical Thinking can successfully use (but it is not obligatory) the acquisitions of Formal Logic. You will see their application below in the section of Results and Discussion.

On the other hand, I study Critical thinking as a specific way of thinking with its own features and qualities. Thereafter I compare them to the main characteristics of Logical thinking. Although they have quite similar and even some of the same qualities, there are very important features that distinguish them. These essential differences do not allow using these two concepts as synonymous and show that they both have to have their own studies for diverse guidance. Thereby, **the main goal of this paper** is to solve the terminological and semantic inaccuracy by showing the difference between critical and logical ways of thinking which substantiates the difference between the academic subjects.

Methods

The complexity of the problem and the hopes of its substantial impact on the future of Ukrainian science, the following methodology was used for this study:

- The historical study of the literature was used to highlight the roots of the terminological misunderstanding Ukrainian science still suffers from.
- The comparative analyses of Western and Ukrainian textbooks on Critical Thinking was made to raise the problem of indecorum of national scientific literature.
- The terminological search in the sphere of cognitive science, contemporary psychology, and philosophy was conducted to determine the main characteristics of Critical Thinking.
- The tabular method of comparison was used to illustrate the theoretical difference between the terms “Critical thinking” and “Logical thinking”.
- The descriptive examples concerning the COVID-19 myths were chosen to show the practical difference between the two ways of thinking.
- Using the instruments of the Critical thinking, I debunk the myths and demonstrate how Logic can serve as an additional tool to Critical Thinking.

Results and Discussion

One of the reasons for the incorrect identification of these two terms has its historical roots. In the early 70s in North America had happened a “thinking revolution” or, how R. H. Johnson calls it, the “Critical Thinking Movement” (see *Johnson, 2012: 10*) signified by excessive attention to the matter of good reasoning. Under such influence, logic, as an academic subject, starts to change too. It leaves behind the formal structures of its artificial language and takes a better look at natural language, which is used in the live argumentation. However, at that time there was no notion of "formal" or "informal" logic, thus, when A. Blair created his first course on Informal logic, it was taught by the name of Critical Thinking (see *Blair, 2011*).

Only in 1978 was held the First International Symposium in Informal Logic that tried to identify the notion of Informal Logic and its difference from the Critical Thinking. It was postulated that “Informal logic emerged as an attempt to teach students about argumentation, how to analyze, evaluate, and construct arguments” (*Johnson, 2012: 18*). While Critical Thinking “involves problem identification and analysis, clarification of meaning, gathering the evidence, assessing the evidence, inferring conclusions, considering other relevant information, and making an overall judgment” (*Hitchcock, 2017*). Thus, the main difference is that Informal Logic works with already proclaimed speech, while Critical thinking attempts to enter the train of thought.

If in Western society this division is already made, in Ukraine we still have problems separating both subjects. Most likely due to the lack of translations of works on Informal Logic. If you take a look at the modern Ukrainian textbooks for university usage (see *Konverskiy, 2020; Tiaglo, 2008*), you will see that the problem is even worth it! These manuals present Critical thinking as a type of logical reflection! Moreover, they propose to study Aristotle's syllogistic, which is not applicable in practice, and propositional logic that is one of the Formal Logic brunches, which works only with the artificial language imposed by special formalization. Critical Thinking has nothing in common with formal structures or artificial languages, because it does not know how to apply them to natural language in practice. That is exactly why Critical thinking sometimes needs the help of Logical Thinking.

Now let us compare them with an American textbook on Critical Thinking. As an example, I have chosen A. Crawford's and others' manual "Teaching and Learning Strategies for the Thinking Classroom" published in 2005 (that makes it older than the Ukrainian textbooks I have mentioned above). At first sight, we may see that this manual is fully focused on the practical side. The main accents are made on understanding narratives, learning information, critical listening and, of course, decoding argumentation, which is the main subject one of the brunches of Informal Logic (to be more precise, Theory of Argumentation). Thereby, you may see that Informal Logic only slightly touches the waste interests of Critical Thinking.

To emphasize once more the difference between the Critical Thinking and Informal Logic as academic subjects, I want to cite again Johnson’s work: "Informal logic designates a type of logic; whereas critical thinking designates both a kind of intellectual practice as well as an educational ideal" (*Johnson, 2012: 18*). Logic as a science (no matter Formal or Informal) will always pay attention to the langue (artificial, e. i. formal or natural) it studies. While critical thinking will try to construct a list of different methods or practices that may help you to build solid good thoughts about some difficult and challenging questions. Thus, both disciplines have different subject fields and priority issues, although they are both relate to the same area of thinking.

Let us see how the present definition of the notion of critical thinking as a process of construction of thoughts. Here are some explanations found in cognitive science, contemporary psychology, and philosophy:

- “Critical thinking is the art of analyzing and evaluating thinking with a view to improving it” (*Paul & Elder, 2006: 4*).
- “Critical thinking is the use of those cognitive skills or strategies that increase the probability of a desirable outcome” (*Halpern, 2007: 6*).
- “Critical thinking consists of seeing both sides of an issue, being open to new evidence that disconfirms your ideas, reasoning dispassionately, demanding that claims be backed by evidence, deducing and inferring conclusions from available facts, solving problems, and so forth” (*Willingham, 2007: 8*).
- “Active, persistent, and careful consideration of a belief or supposed form of knowledge in the light of the grounds which support it and the further conclusions to which it tends” (*Dewey, 1910: 9*).
- “Knowledge of the methods of logical inquiry and reasoning; and some skill in applying those methods” (*Glaser, 1941: 5*).

ISSN 1728-9343 (Print)
ISSN 2411-3093 (Online)

- "Critical thinking is skilled and active interpretation and evaluation of observations and communications, information and argumentation" (*Fisher and Scriven, 1997: 21*).

As it may be seen, only one of the proposed above explanations relies on logic. The term "critical" specifies itself the evaluating and choosing process of thinking, while "logical", coming from the Ancient Greek word "λόγος", which means "word" or "reason", shows its connection to the language and the process of reasoning. It is crucial for logical thinking to have a correct form or structure that to induce the same conclusions from the same inferences. Thus, this connection is stable and firm. Critical thinking compares the possible answers to choose the better of them, not the one that is solely correct, as logic does, but the one that suits all the parameters. Let us take a look at this comparative table to see which features these two types of thinking have in common and in which they differ from each other.

Table 1. Common and different characteristics of Critical and Logical thinking

Critical thinking	Logical thinking
Both are **non-automatic** and **effortful** types of **reasoning**. Using the terminology of the Dual-process theory, we may say that the two of them need System 2 to work.	
Critical thinking *"describes reasoning in an open-ended manner with an unlimited number of solutions"* (Halpern, 2007: 6). This **flexibility** unites critical thinking with creative thinking, giving it the possibility to resolve the problem in a different manner and find various solutions by using **nonlinear reasoning**. In other words, critical thinking does not reject seemingly false choices but put them aside to use in case they are needed in the future.	Logic is first of all vertical or **linear** type of **reasoning**. Because of this ability, it can be traced retrospectively. Logical reasoning consistently seeks the solution to the problem by eliminating the wrong options. Therefore, if on one point one the "seemed-to-be-right" answers prove to be "wrong" the whole reasoning will be erroneous too.
Both operate with the **argumentative position**, using statements analysis and judging evidence.	
Critical thinking allows us to **interpret concepts**, symbols, and meanings in a diverse manner. That is why it can be used to study art (see *Khomenko, 2020*). On the other hand, it can be itself studied though the arts (see *Barber, 2015; Bowen, et al., 2014*)	Logic requires **one clear definition** of all the concepts it operates. The law of identity is one of the basic logical regulations that should not be violated. The substitution of concepts is a logical fallacy that occurs when a violation is in process and can lead to erroneous conclusions.
Both try to establish **causal relations** using inductive or deductive inferences.	
Critical thinking is **unconventional, lateral thinking** that can be built on unproven assumptions, untested hypotheses, and fantastic suppositions that acquire the acceptability status through the process of comprehension.	Logical thinking has a **clear structure**, which implies having some working models and strong regulation rules. Thus, logical reasoning must always draw the same conclusions from the same inferences.

To understand better the difference between critical and logical thinking, I propose to analyze some false statements by using the instruments of critical thinking. I have chosen two widespread fake news about COVID-19:

- Myth No 1 – COVID-19 is spreading by the 5G network (see BBC, 2020a).
- Myth No 2 – COVID-19 afraid of the hot weather (see *The ASEAN Post, 2020; BBC, 2020b*)

Let us start with the first statement. Unfortunately, the conspiracy theories have always been popular, despite their lack of logic. What we know for sure about the Coronavirus? It is a virus! Biologically speaking viruses are the small infectious agent that lives and replicates only inside the living cells of a human or animal organism. It cannot be spread by radio waves or the Internet. Besides, according to statistics, some countries with no 5G networks, like India, for instance (7,122,862 cases on 12.10.2020 according to worldometer.info) suffer more from COVID-19 than the countries, like Switzerland, for example (64,436 cases on 12.10.2020 according to worldometer.info), that have 5G connection. We can present all this information as separated theses, or statistical charts, or we can use the above information to build logical reasoning. All of them will be equally useful and interchangeable. For this example, I decided to use the proof by contradiction:

1. Suppose Coronavirus can be spread by radio waves provided by the 5G network.
2. Thus, those countries, which have 5G telecommunications towers, should have a higher incidence of cases of COVID-19.
3. Yet, they are not.
4. Therefore our supposition is wrong – the Coronavirus does not spread by radio waves provided by the 5G network.

Now to the second assumption. We can admit two interpretations. On the one hand, we can assume that Coronavirus does not tolerate the hot weather. If it were true, there would be more cases in cold countries than in other hot places. To demonstrate the falsity of this statement, we can use a comparative table that shows the rate of cases in the hot and cold countries or the statistical diagrams as it presented below.

In the diagram (Figure 1), we can clearly see that there are more cases in the countries with a hot climate than with the cold one. Thereby, we can conclude that the information about hot weather virus intolerance is not true. On the other hand, we can imagine that people, who live in hot countries, taking sunbathing and constantly getting their vitamin D, could have a better immune system than those people who live in cold and cloudy weather.

Therefore, people with better immune systems should be harder to affect by viruses. However, the statistics show that hot weather and the sun are not the panaceas from Coronavirus. The human immune system needs more components than just nicely climate.

To debunk this myth we can just as well use the logical rule of inference, for instance, the modus tollens.

1. If a hot climate kills Coronavirus, there should not be any cases of COVID-19 in South Africa.
2. There are 692,471 cases on 12.10.2020 of COVID-19 in South Africa according to worldometer.info.

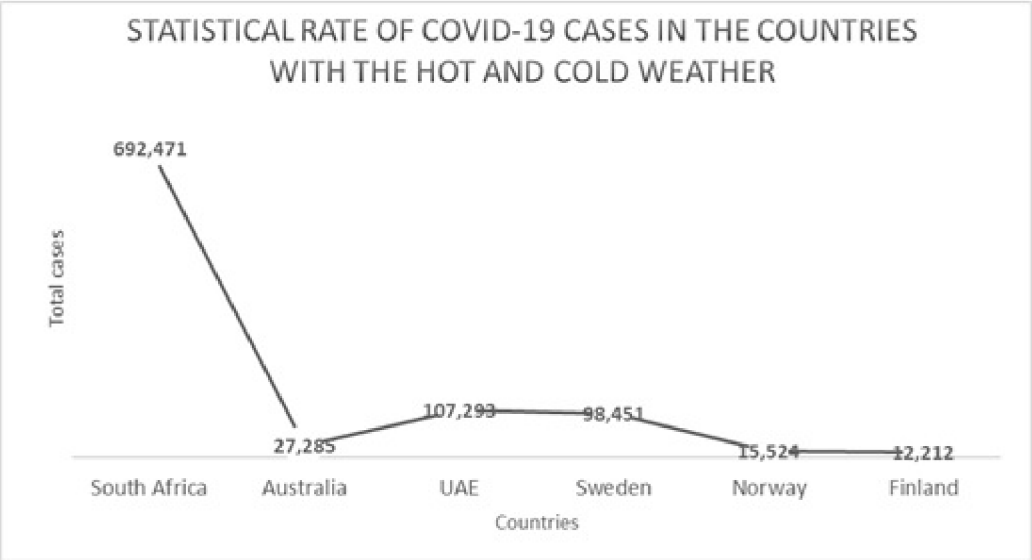

Fig. 1. Statistical rate of COVID-19 cases in the countries with the hot and cold weather. (The numbers are taken from the *worldometer.info*)

3. Thus, a hot climate does not kill Coronavirus.

Thus, the examples demonstrated above proved that both myths could be debunked in a diverse manner both using and not using logic. Naturally, logical deduction makes our proof more solid, significant, and evidential, but it is not mandatory or unique. As it is marked by F. van Eemeren and his colleagues, "the methods of informal logic were – and are – among the tools used to achieve the goals of critical thinking" (*Van Eemeren, 2013: 5*). However, unfortunately, Logic is limited by its own regulation rules and laws and can be biased in its own way. As M. Kovic said, "critical thinking as a metacognitive skill consists of three components: minimization of logical fallacies, minimization of cognitive biases, and a probabilistic epistemology" (*Kovic, 2016: 3*). Therefore, the critical thinker does not focus on one solution and tries to find as many explanations as possible, rethinking various contexts and seeking for better models.

To sum up, as you may see from the previously mentioned information, critical thinking is more than just logical thinking, but it can include the last one as one of its instruments. As noticed by D. Hitchcock, "critical thinking differs from the logical appraisal of arguments in extending beyond a single argument, having a creative component, and involving critical assessment of evidence" (*Hitchcock, 2017*). Critical thinking is a necessary addition to logical thinking. If people only used logical reasoning on any matter, we would have a nation of Spocks unable to have any emotions and irrational spontaneous decisions. Critical thinking helps us to deal with our bounded rationality by improving our movement of thought.

Conclusions

The purpose of this paper was to emphasize the significant difference between Critical and Logical thinking, which implies the necessity of two different studies. As it was showed in the previous section, unfortunately, Ukrainian science does not differentiate Critical thinking from the course on Logic. However, the two disciplines make different accents on the thinking process they both study. After all, that was said above, it is inevitable to conclude that Critical Thinking is, in the first place, a practical study. Its purpose is to give people the needed tools to make good decisions, to decode obtained information, to oppose the manipulation, and so on. While Logics' goal depends on the subject it studies. For instance, for the Formal Logic, it is important to build the logically correct inferences. Therefore, Formal Logic pays all its attention to the formalization process of human reasoning. At the same time, the Informal Logic observes the natural language as well as Critical Thinking. The main difference between them is that the Informal Logic works basically with the language that was already proclaimed, while Critical Thinking generally uses it as the material for new reasoning.

On the grounds of their differences, the necessity of writing a new Ukrainian textbook on Critical thinking for Ukrainian students becomes obvious as well as an introduction of the new course on the Critical thinking in Ukrainian universities. Logical thinking is, unfortunately, bounded by its own rigor rules, which are hard to keep in real life. Critical Thinking as it is based on the real and somehow chaotic human thinking (and not the ideal version, as Logic sees it) is one of the most crucial skills of our times. The simplest example of its implication is that Critical thinking can help people not to panic each time the new (does not matter true or false) information about the COVID-19 pops up. Thereby, Critical thinking may help to maintain the mental stability of the nation during the pandemic time. Nevertheless, it can prevent people from the manipulation of political candidates before elections or the deceptions of information war.

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РОЛЬ ЛОГІКИ У КРИТИЧНОМУ МИСЛЕННІ

Стаття присвячена виявленню відмінностей між критичним мисленням і логікою як двома способами раціонального мислення та як навчальними дисциплінами у вищій школі. Стверджується, що помилкова асоціація цих двох типів мислення впливає на те, яким чином викладаються обидві дисципліни. Показано, що інколи в українських університетах відбувається підміна змісту курсу критичного мислення на курси з формальної чи неформальної логіки. Крім того, усі існуючі українські посібники з критичного мислення присвячені лише логічним питанням. І хоча логіка може дати деякі важливі та корисні інструменти, в статті доводиться, що цього недостатньо для правильного використання критичного мислення. Надається порівняльна характеристика критичного та логічного мислення на основі базових параметрів. Аналізується, які характеристики є спільними для обох типів мислення, а які різні. Наводиться порівняльна таблиця з конкретними прикладами, які свідчать про розбіжність критичного мислення і логіки. Розкривається історичне коріння усталеного термінологічного непорозуміння в буденній свідомості щодо ототожнення критичного і логічного мислення. Зазначено, що західна наука вже давно розвела ці дисципліни та визначила основні пріоритети і проблеми для кожної з них. Однак в Україні ми все ще маємо деякі «проблеми з розмежуванням» через відсутність глосарію та помилкову асоціацію цих двох способів раціонального мислення. Щоб довести помилковість заявленої подібності, автор вивчає дві популярні фейкові новини про COVID-19, викриває обидва міфи, використовуючи різні засоби, надані логікою та критичним мисленням, і доводить, що вони є самодостатніми і можуть використовуватися окремо й незалежно один від одного. Стверджується, що критичне мислення – це базова мисленнєва навичка, особливо в кризовий період існування соціуму. Тому надзвичайно важливо, щоб критичне мислення почали правильно викладати в Україні та використовувати не лише в науковій діяльності, а й у повсякденних практиках.

Ключові слова: *критичне мислення; логічне мислення; неформальна логіка; КОВІД-19.*

Надійшла до редакції: 02.09.2020
Прийнята до друку: 30.09.2020