Critical Thinking

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Definition

The term critical has its origin in the Ancient Greek word κρίνειν (krinein), which means "discerning, judging". Critical thinking is therefore to be understood as thinking that aims at reasonable judgment. There is consensus about the basic concept as careful reflective thinking (Allen et al. 2020; Hitchcock 2018). To be groundlessly skeptical about anything or to blindly follow a rule is not critical thinking.

The basic concept can be found in different formulations. In a consensus paper known as the Delphi Report, by a panel of 46 experts with different scientific backgrounds ranging from philosophy to physics, zoology, psychology, social sciences and economics, critical thinking is defined as "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (Facione 1990, 3). Ennis (1993, 180) characterizes it as "reasonable reflective thinking about what to believe or do". Bailin et al. (1999, 287) add that it is thinking for the purpose of making up one's mind about what to believe or do and, in doing so, trying to fulfill certain standards of adequacy and accuracy of thinking. Critical thinking is rational thinking in the following sense: "To be a critical thinker is to be appropriately moved by reasons" (Siegel 1988, 32). Reasons are related to criteria and standards (Lipman 1987).

To educate for critical thinking means to aim for the ideal of a critical thinker. The ideal critical thinker is one who is "habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit" (Facione 1990, 3). Hence, to be a critical thinker requires knowledge,

skills, and dispositions (habits). Knowledge of the critical thinker includes, among others, the concepts of observation and inference, of conclusive and defeasible inference, of necessary and sufficient conditions, of hypothesis and prediction, of argument, premise, and conclusion (Hitchcock 2018).

The skills of the critical thinker can be categorized under the headings of (1) interpretation, (2) analysis, (3) evaluation, (4) inference, (5) explanation, and (6) self-regulation (Facione 1990, 8). The last one includes the recognition of the influence of emotions. It also involves the use of strategies for dealing with cognitive biases (Stanovich and Stanovich 2010). Skills are not sufficient because one can have them and not use them, and hence not be a critical thinker; therefore, certain additional dispositions are needed. The relevant dispositions, understood as habits and attitudes that contribute to being a critical thinker, include attentiveness, the attitude of inquiry, self-confidence, courage, open-mindedness, the willingness to suspend judgment, trust in reason, and the search for truth (Allen et al. 2020; Facione 1990, 25; Hitchcock 2018).

Many subjects are becoming increasingly complex in theory as well as in their practical application and require the integration of multiple disciplines and stakeholders. Critical thinking solidifies as a necessary competence for doing and interpreting research. It is a central educational goal and serves as basis for (higher) education policymaking.

Background

Critical thinking is considered to be one of the central skills in higher education and research and also increasingly in the public sphere (post-truth era, social media, and the use of artificial intelligence in different fields, notably in text production). Its origin lies in philosophy and finds application in all fields, from the humanities to social sciences and natural sciences. Teaching critical thinking involves crossing the boundaries of traditional disciplines and helping to develop general thinking skills such as conducting an inquiry (which involves, among others, the ability to formulate a research question, to effectively search for relevant information, to assess the epistemic justifications of claims made and the truthfulness of sources, to assess the usefulness of the information for answering the research question, to apply methods of investigation, etc.). Such skills are central to transdisciplinary learning and research.

The concept and educational goal of critical thinking has a longer history than its name. An older, more rationalist conception of critical thinking goes back to the Age of Enlightenment, in particular to Kant, who in a famous article pleaded for the courage to use the faculty of reason (Kant 1784, 481). Another, more empiricist conception goes back to Dewey, who, inspired by Bacon, Locke, and Mill,

described what he called "reflective thought" as follows: "Active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends, constitutes reflective thought" (Dewey 1910, 6). Dewey (1916) stressed the relation between critical thinking and democratic participation. Both conceptions aim at teaching autonomous thinking.

In the 1930s, Dewey's ideas of teaching thinking through inquiry were put into practice at several schools in an eight-year study of the Progressive Education Association. Glaser (1941) developed a test for measuring critical thinking abilities, and showed that they can be improved through education. Later, in the 1970s, Lipman (2003) took up Dewey's idea of inquiry and applied it to philosophy with children. Critical thinking abilities were included in Bloom's influential taxonomy of cognitive learning objectives (Bloom et al. 1956). A landmark in the research on critical thinking was Ennis (1962), who proposed a list of 12 aspects of critical thinking as a basis for research and evaluation. The movement of critical thinking and the movement of informal logic influenced each other. They led, from the late 1970s and 1980s, to the creation of associations, to international conferences, and to the creation of scientific journals (Lipman 2003).

Debate and criticism

Critical thinking is a central educational goal. What is the justification for it? There are several fundamental reasons: to respect the students as persons, which means, among others, to recognize their right to ask for reasons and justifications, to empower them to control their own destiny, to initiate them into the rational traditions, and to prepare them for democratic living (Siegel 1988, 55–61). Education in critical thinking is opposed by those who see the fundamental aim of education as the preservation and tradition of given values or the indoctrination of an ideology.

Critical thinking has been criticized for favoring certain kinds of thinking and knowledge over others, in particular reason over emotion, imagination, intuition, and collaborative inquiry (e.g. Thayer-Bacon 2000). However, such criticism presupposes too narrow a concept (for further references and discussion, see Allen et al. 2020; Hitchcock 2018). A basic concern is the relation between general and domain-specific skills, both conceptually – are there general critical thinking skills? – and didactically – can general thinking skills be taught as an independent subject? McPeck (1981) argued that there are no general (critical) thinking skills since all thinking is about some subject matter. There are obvious counterexamples to this, e.g. the abilities to identify assumptions, to reason from premises to conclusions, or to recognize a confusion of necessary and sufficient conditions

(Siegel 1988, 20). McPeck used the argument also to support the claim that critical thinking skills can only be taught in subject-specific courses. This didactical claim is more controversial. Lipman argues that the existence of philosophy and logic, which are concerned with specifying what good thinking ought to be, shows that it is wrong (Lipman 2003, 44). But the question remains how critical thinking can be learned.

Arguing against teaching critical thinking in a separate course focusing on informal logic (which has become common in college education in the United States), it has been noted that the focus on single arguments taken out of context does not help much in acquiring critical thinking abilities since these require knowledge of the area, knowledge of methodological principles and norms of practices specific to the area (Bailin et al. 1999). Instead, according to Bailin and her colleagues, students should be engaged in tasks pertaining to complex issues calling for reasoned judgment, and they should be supported in developing the abilities to do so. On the other hand, learning general thinking skills cannot take place only within disciplines, as this would ignore those aspects of argumentation that transcend the boundaries of the disciplines, such as the procedures for conducting an inquiry, the analysis of arguments, and the evaluation of sources (Battersby and Bailin 2015).

Ennis (1989) distinguishes four types of approaches to teaching critical thinking: general, infusion, immersion, and mixed. (1) The general approach teaches principles of critical thinking explicitly and independent of a subject matter. (2) The infusion approach combines subject matter teaching with making principles of critical thinking explicit. (3) The immersion approach encourages students to think critically in a subject without making the principles of critical thinking explicit. Finally, (4) the mixed approach combines the general approach with either the infusion or the immersion approach. Abrami et al. (2015) found in a meta-study that all four types of approaches lead to a significant increase in critical thinking skills, and no big differences between the approaches could be observed. Additionally, they used a classification into the following categories: dialogue (learning through discussion), anchored instruction (learning through analysis of real-world problems), and mentoring (one-to-one interaction with a mentor). They figured out that all three categories had positive effects on the critical thinking outcomes. The largest effect in terms of a gain in the ability to think critically was achieved in courses where a combination of all three aspects was present.

The result of any study purporting the measurement of gains in critical thinking ability faces the criticism of how to measure such gains. First, it "requires that we be clear about what we are trying to assess" (Ennis 1993, 179). This means that a definition of critical thinking is needed. Standardized test inventories exist for different definitions (for an overview see Ennis 1993 and the supplement on assessment in Hitchcock 2018). While such tests are used for the assessment of the knowledge and abilities aspects of critical thinking, it is much more difficult to

evaluate gains in attitudes, especially since these might only develop slowly, calling for more long-term research in this area.

Jahn (2012) distinguishes four standards of thought: analysis, perspectivity, ideological criticism, and constructivity. Analysis is concerned with the assessment of arguments. Perspectivity means to take on multiple perspectives and contrast them with each other. As human beings, we are biased in favor of our own perspective, sometimes including views from our own (often small) in-group. Critical thinking requires grasping multiple perspectives, sharpening one's own perspective, and assessing reasons to hold it. This is especially true when normative questions are in focus. To be a critical thinker sometimes requires ideological criticism which involves analysis of the (hidden) power structures. Such structures can be found not only in political contexts but also in institutions such as a university or committee that decides on the distribution of funds for research in different fields. Finally, constructivity means developing new solutions to a problem. It can also mean developing action plans that help improve practice.

Current forms of implementation in higher education

Critical thinking is implemented as an educational goal in educational systems and institutions across the world. The teaching is often done in a course devoted to critical thinking. Useful material for such courses can be found, for example, on the University of Hong Kong's Critical Thinking Web (Lau and Chan 2023). However, education in critical thinking is not restricted to such courses.

Identifying successful didactical approaches helps to elucidate factors that are conducive for learning critical thinking (for a study about practices in institutions of higher education in the global south, see Okolie et al. 2022). Significantly better outcomes are found in forms of teaching that involve some kind of mentoring along with dialogue-based instructions and the use of authentic tasks. While using real-world examples clearly increases the relevance of the topic (for the students), and hence fosters students' intrinsic motivation, the findings that dialogue-based instruction has even greater effects highlight the importance of cognitively activating methods. This effect is especially strong when roleplaying is used (being a combination of real-world tasks and dialogue-based instruction, Abrami et al. 2015, 299). The boost in effect when adding elements of mentoring, in turn, emphasize that feedback and some form of guidance are beneficial. Indeed, teaching critical thinking often starts with an initial irritation. This can be in the form of a real-world problem, presented as a text, a video, research data, etc., which triggers in the students the urge to resolve it.

The meta-study by Abrami et al. (2015) cuts across all disciplines. Different aspects of teaching critical thinking can be illustrated by a course, designed in the

context of the critical thinking initiative at ETH Zurich, titled Scientific Concepts and Methods (Sieroka et al. 2018). It is a compulsory, one-week course in the Master's program of the pharmaceutical sciences curriculum. Each day, the students receive input on a certain aspect of the philosophy of science (e.g. scientific reasoning, use of images) and input on a thematically aligned scientific method in modern biomedicine (e.g. reproducibility models in drug development, biomedical imaging), leading up to an interdisciplinary discussion of each day's topic together with the philosopher of science and the biomedical expert.

When planning to integrate critical thinking as an intended learning outcome, it is necessary to clarify which standards of thought should be considered. One can follow the four standards by Jahn (see above). Analysis can be taught in a separate course but might as well be integrated into any subject matter that deals with arguments, such as devising formal proofs in mathematics, interpreting experimental results in the natural sciences, debating arguments in political sciences, or justifying value judgments in economics. Classical debates can be one means to integrate the analysis of arguments into a course. Writing an argument based on a scaffolded structure and then giving feedback to and receiving feedback from course peers can be another (Kölbel and Jentges 2017). In order to achieve the standards of perspectivity, students need to be exposed to multiple perspectives on the topic or issue. However, mere exposure is not enough. It is essential also to take on the perspective of others, as in the examples before or in role play, which has a rather high impact in terms of gains in critical thinking (Abrami et al. 2015). Adding transdisciplinary elements into a course can be a great opportunity for students to take on new and different perspectives, either from experts in a different field or from people who are unfamiliar with the research field in question. This can feel rather odd for teachers who are used to passing on knowledge to students. If critical thinking is one of the aims of the course, the teacher should act as a role model of a scientist in the field and share not only the standard canon of knowledge, but also its uncertainties and boundaries, as well as the scientific attitude of dealing with such uncertainties. Including a historical perspective in the course may help to shed light on the process of scientific development – a useful text here is still Kuhn's The Structure of Scientific Revolutions (1962).

Including aspects of ideological criticism in a course can add to the curiosity of students and hone their critical thinking skills. At the level of constructivity, students are asked to find constructive solutions to existing problems and invited to integrate their newly acquired knowledge into their everyday (professional) lives. It is therefore important to allow the students to relate any subject matter and critical discussion to their own context, ideally to some work or produced output of their own. Adding elements of the scientific process to a course can lead to high engagement of students and the acquisition of critical thinking skills. These can involve the writing (and peer reviewing) of grant proposals, article abstracts,

scientific presentations, and posters. The use of mentoring will increase the likelihood of students successfully learning to think critically.

The intended learning outcome of a single course cannot be to become a critical thinker because this requires much more time. It is rather to be seen as part of the aims of education in general (or even of lifelong learning). For a particular course, it is helpful to specify which aspects of critical thinking will be in focus and what the teacher expects the students to learn (for example, to be able to reconstruct an argument, to be able to apply their critical thinking skills in real-world problems or to acquire the habit of a critical thinker to be open to new information and to objections). A very effective way is to offer learning activities to students where they can practice, for skills can only be acquired by practicing.

Generally, aligning the learning activities and the assessment to the intended learning outcomes is a basic requirement of good teaching (Biggs and Tang 2011). And a learning and teaching culture that de-emphasizes teacher-centered or solution-focused teaching approaches are likely to be conducive to learning critical thinking (Okolie et al. 2022).

But how should the assessment be done? In order to answer this question, one should first be clear about the purposes of the assessment: Is the primary purpose to diagnose the individual (or collective) level of critical thinking as information for the teacher (or for some institution)? Is it to give feedback to the students so that they know what they are good at and where they need to improve? Is it to motivate students by letting them know what they have learned?

The methods to be used in assessment can vary. One can either use one of the commercially available tests in English (see Norris and Ennis 1989 for guidelines choosing among them) or devise one's own multiple-choice test (see Norris and Ennis 1989 for recommendations). However, devising a valid multiple-choice test is challenging and time-consuming. Since it is inherently difficult to comprehensively assess critical thinking using closed questions, Ennis (1993, 184) recommends asking for a brief written defense of the chosen answer, and generally implementing open assessment formats, especially when going beyond the diagnostic aspects of the exam. Open-ended techniques include short-answer tests, argumentative essays, and individual interviews (Norris and Ennis 1989). Other, rather open forms of assessment can also be used, for example doing a case study, designing a poster, or taking part in a panel discussion.

Due to a widespread bias, one aspect in teaching is often underestimated: the expert blind spot. The time it takes to learn to think critically (or to learn anything for that matter) must not be underestimated. Learning does take time, and so does learning of critical thinking.

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